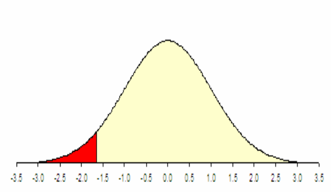
Exhibit 1



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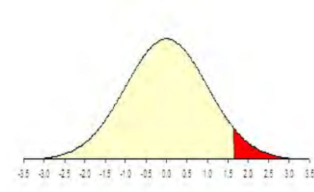

Expert Report of Dr. Thomas W. Sager
May 21, 2015

Expert Qualifications

§1. I am professor of statistics in the Department of Information, Risk, and Operations Management in the McCombs School of Business at the University of Texas at Austin. I have a PhD in statistics from the University of Iowa in 1973. I have 41 years of experience teaching a wide variety of statistics courses, research in the theory and applications of statistics, and extensive consulting. My resume is provided as an Attachment to this document.

Introduction and Scope

§2. I have been retained by Edwards Law and The Singley Law Firm to provide testifying expert statistical services and assistance in connection with the case *Bailey, et al. v. Livingston, et al.*, cause no. 4:14-cv-1698, in the United States District Court, Southern District of Texas (Houston Division) ("Bailey"). In particular, I was asked to create a statistical model for the accurate estimation of the heat index at three interior locations in the Texas prison system for the period June 17, 2014 through August 26, 2014. Data measurements of the temperature and humidity are available for the prison at each of the three locations for the period August 27, 2014 through October 8, 2014, but not prior to August 26, 2014. Data measurements of temperature and humidity are also available from the Brenham, Texas airport, which is 18 miles from the prison, for the entire period June 17, 2014 through October 8, 2014 – except for an outage of 2 hours' duration on August 12, 2014. In brief, the statistical modeling procedure involves two steps. First, derive equations that fit the known measurements at the interior prison sites to the Brenham weather data for the period when both locations have available data (August 27 – October 8). Then input the Brenham weather data for June 17 – August 26 into those equations to estimate the measurements at the interior prison sites for the period before measurements commenced at the prison sites.

§3. My fees are not dependent on my findings, opinions or on the outcome of the related arbitration. My hourly rate is $200. In my analysis, I have not been assisted by any other persons. My findings are my own. In arriving at my findings, I rely upon the accuracy and completeness of the data with which I have been provided, including the temperature and humidity measurements at the three prison sites and on the data from the Brenham airport.

§4. I reserve the right to supplement and/or revise my report at a later time if new, additional, or corrected information is obtained, or if I am asked to address additional issues or to re-analyze any issues discussed herein.

Data Sources

§5. The data sources for my analysis include:

- An Excel file, "Brenham Airport Temperatures and Humidity May8-Oct8, 2014 Weather Underground NOT CERTIFIED.xlsx", which contains 10,138 rows of data of temperature and humidity measurements at the Brenham, Texas, airport. There are three measurements per hour over the period June 17, 2014 through October 8, 2014, except for two missing hours on August 12, 2014.
- Three Excel files : "Pack_A_dorm_entry_249.csv", "Pack_C_dorm_entry_243.csv", and "Pack_D_dorm_entry_636.csv", each of which contains 6,095 rows of data of temperature and humidity measurements at the three interior prison sites. There are six measurements per hour over the period August 27, 2014 through October 8, 2014.
- For the calculation of the heat index from temperature and humidity, I used the heat index formula given at the National Weather service website http://www.hpc.ncep.noaa.gov/html/heatindex_equation.shtml

§6. Preparing the Data for Analysis

Since the prison and Brenham data were measured at different frequencies – six measurements per hour for the prison data and three measurements per hour for the Brenham data – the data were converted to a common frequency scale by averaging the six or three measurements within each hour at the respective sites. Each day therefore has 24 hourly measurements of temperature and of relative humidity.

Figures 1 and 2 show the hourly temperature and humidity, respectively, at the three interior prison sites ("Dorm A", "Dorm C", and "Dorm D") and the Brenham airport for the period August 27 – October 8 of mutual data availability. Figures 3 and 4 show the hourly temperature and humidity, respectively, at the Brenham airport for the period June 17 – August 26, before measurements commenced in the prison.

§7. The Heat Index

The heat index is calculated from the temperature and relative humidity by the following equation:[1]

- HI = 0.5 * (T + 61.0 + (T-68.0)*1.2 + RH*0.094).
- if (HI + T) ≥ 80 then
  HI = -42.379 + 2.04901523*T + 10.14333127*RH - .22475541*T*RH - .00683783*T*T - .05481717*RH*RH + .00122874*T*T*RH + .00085282*T*RH*RH - .00000199*T*T*RH*RH.
- if RH < 13 and 80 < T < 112 then HI = HI - ((13-RH)/4)*SQRT((17-ABS(T-95.))/17).
- if RH > 85 and 80 < T < 87 then HI = HI + ((RH-85)/10) * ((87-T)/5).

[1] Source: National Weather Service at http://www.hpc.ncep.noaa.gov/html/heatindex_equation.shtml

where HI is the heat index, T is the temperature, RH is the relative humidity, SQRT means square root, ABS means absolute value, and * means multiplication.

The four bulleted expressions are calculated sequentially, with the value for HI that is calculated in one bullet being modified in subsequent bullets. Thus, the first bullet gives a basic computation of HI. However, if this value plus the temperature exceeds 80, then the computation in the second bullet replaces that of the first. Under certain conditions on the relative humidity and temperature, the third and fourth bullets can further adjust the value calculated for HI in the first or second bullet. Once the temperature and relative humidity are given, the heat index can be calculated by inputting the temperature and relative humidity directly into the above four bulleted expressions and executing the bulleted expressions one after another. The text of the four bullets can be lifted almost verbatim and inserted as code into a computer program to calculate the heat index.

§8. Goal of the Analysis

The goal of the analysis is estimate the heat index at the three interior prison sites for each hour in the period June 17, 2014 – August 26, 2014, before the prison sites commenced measurements of temperature and humidity (and hence of the heat index).

§9. **Summary of Conclusions**

Regression equations are developed by two different methods to estimate the hourly heat index at the three interior prison sites for the period August 27-October 8, 2014, when data are available at both the prison sites and the Brenham airport. Comparison of the estimated heat index with the actual heat index at the three prison sites shows that the equations can accurately estimate the heat index for the three prison sites. Correspondence between the actual prison heat index and the regression estimates is high: R-squares are in the mid-90 percent range, and the average magnitude of the deviation between actual heat index and regression estimate is approximately 1-1.5 degrees. Comparable agreement between estimated heat index and actual heat index can be expected for the June 17-August 26 period as for the August 27-October 8 period. Finally, the regression equations are applied to estimate the hourly heat index at the three interior prison sites for the period June 17-August 26, 2014, when data are available only at the Brenham airport. Comparison of the two regression methods shows close agreement in the estimates. Graphs and tables are provided to display the estimates.

Step 1: Modeling the Heat Index for the August 27-October 8 Period

§10. Developing the Estimating Equations for the Heat Index

The first step in the analysis is to derive equations that fit the known measurements at the prison sites to the Brenham weather data for the period when both locations have available data (August 27 – October 8). Since the heat index is computed from temperature and relative humidity, the temperature and relative humidity at the prison sites can be estimated and the heat index computed from these estimates (Method 1). Or the heat index at the prison can be estimated directly (Method 2). The two methods:

1. Estimate the temperature and humidity at the interior prison sites from Brenham data, then calculate the heat index from the estimated temperature and humidity.
2. Estimate the heat index directly from Brenham data.

Both methods were employed in order to provide a check on results. The results were quite similar.

Step 1: Method 1

§11. Method 1 is a multiple regression model. Multiple regression was selected because it is a standard statistical methodology for estimating a numerical dependent variable on the basis of multiple numerical independent variables. In the Bailey case, one version (Method 1) of the regression model first takes the dependent variable to be the temperature inside the prison and the independent variables to be temperature and humidity by the hour at the Brenham airport. Then Method 1 next takes the dependent variable to be the humidity inside the prison and the independent variables to be temperature and humidity by the hour at the Brenham airport. Finally, from the regression estimates of temperature and humidity inside the prison, the heat index inside the prison is calculated from the equation used by the National Weather Service.

§12. Separate regression models were developed for each of the three prison sites (Dorm A, Dorm C, Dorm D) for each of temperature and humidity – a total of six regressions. Three of the regressions have the prison temperature as dependent variable; three of the regressions have the prison humidity as dependent variable. The independent variables are the temperature and humidity at the Brenham airport for the corresponding hour as at the prison, together with the temperature and humidity at the Brenham airport for each of the four preceding hours, and 0-1 indicator variables for each hour of the day. For example, the form of the regression equation for estimating temperature at Dorm A is

$$\begin{aligned} DormAT_t = \quad & \alpha + \beta_1 T_t + \beta_2 T_{t-1} + \beta_3 T_{t-2} + \beta_4 T_{t-3} + \beta_5 T_{t-4} + \gamma_1 H_t + \gamma_2 H_{t-1} + \gamma_3 H_{t-2} + \gamma_4 H_{t-3} + \gamma_5 H_{t-4} \\ & + \delta_1 I_1 + \delta_2 I_2 + \delta_3 I_3 + \cdots + \delta_{23} I_{23} + \varepsilon_t \end{aligned}$$

where $DormAT_t$ means the temperature in Dorm A at time *t*, T_t is the Brenham temperature at the same time *t*, T_{t-1} is the Brenham temperature in the preceding hour *t*-1, T_{t-2} is the Brenham temperature in the 2nd preceding hour *t*-2, T_{t-3} is the Brenham temperature in the 3rd preceding hour *t*-3, T_{t-4} is the Brenham temperature in the preceding hour *t*-4, $H_t, H_{t-1}, H_{t-2}, H_{t-3}, H_{t-4}$ are correspondingly the Brenham humidity in the same and four preceding hours, I_1 is an indicator that has the value 1 if the current hour is the hour following midnight and has the value 0 otherwise, I_2 is an indicator that has the value 1 if the current hour is the 2nd hour following midnight and has the value 0 otherwise, $I_3, I_4, ..., I_{23}$ similarly are indicators having values 1 or 0 for each of the 3rd through 23rd hours following midnight,[2] $\alpha, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \gamma_1, \gamma_2, \gamma_3, \gamma_4, \gamma_5, \delta_1, \delta_2, \delta_3, \cdots, \delta_{23}$ are parameters to be estimated by the regression, and ε_t is an error term that represents the difference between the actual Dorm A temperature at time *t* and the estimate of that temperature given by the regression model.

[2] The 24th hour is omitted for technical reasons to avoid a multicollinearity – standard procedure for models that use indicators.

§13. The regression models for Dorm C temperature and Dorm D temperature have the same form, except for the replacement of $DormAT_t$ by $DormCT_t$ or $DormDT_t$ on the left hand side of the equation. The forms of the regression models for estimating humidity at Dorms A, C, D are the same, except for the replacement of the temperature variables $DormAT_t$, $DormCT_t$, $DormDT_t$ by the humidity variables $DormAH_t$, $DormCH_t$, $DormDH_t$ as dependent variables.

§14. Since the unit of observation is one hour, the sample size exceeds 1,000 observations. The sample size is more than adequate to provide for accurate estimation of the regression equations. The numerical estimates of the parameters for all six regression equations of Method 1 are displayed in Table 1. Table 1 also displays numerical assessments of how well each equation works, including R-square, the mean absolute deviation (MAD), the inter-quartile range (IQR) and 95 percent confidence intervals for the error.

- R-square is a standard measure of how strongly the estimates correlate with the actual data. R-square is a number between 0 and 1, with values close to 1 indicating higher correlation and better fit.
- MAD is the arithmetic mean of the magnitude of deviation between the regression estimate and the actual data. MAD tells how close the estimate is to the actual data, on average. The smaller the MAD, the better.
- IQR is a 50 percent confidence interval for the errors. Half of the differences between estimates and actual data are within this range; half are outside.
- 95 percent of the differences between estimates and actual data are within the 95 percent confidence limits; only 5 percent are outside.

These numerical assessments, as shown in Table 1, show that each regression equation works very well. The R-squares are consistently very high, and MAD consistently low. Graphical evidence of the good correspondence between estimates and actual data is provided in Figures 5-13, as discussed in the following paragraphs.

§15. Figures 5-7 show overlays of the regression model estimates of hourly temperature on the actual hourly temperatures at each of the three interior prison sites for the period August 27-October 8 of mutual data availability. The regression models each have R-squares of about 97% and average magnitude of hourly deviation between actual and estimated temperatures of about 0.8-0.9 degrees.

§16. Figures 8-10 show overlays of the regression model estimates of hourly humidity on the actual hourly humidity at each of the three interior prison sites for the period August 27-October 8 of mutual data availability. The regression models each have R-squares of about 93% and average magnitude of hourly deviation between actual and estimated relative humidities of 2.5-3.0 percent.

§17. Next, the heat index was calculated from the estimated temperature and estimated humidity at each of the three prison sites for each hour in the period August 27-October 8 of mutual data availability. The National Weather Service equation discussed in §7 was used for this purpose. The actual heat index was also calculated using the same equation at each of the three interior prison sites for each hour in the period August 27-October 8 of mutual data availability. Figures 11-13 show overlays of the hourly heat index, as calculated from the estimated temperature and

estimated humidity, on the actual hourly heat index at each of the three interior prison sites for the period August 27-October 8 of mutual data availability. The overlays have R-squares for the correspondence in the range 95-96% and have average magnitude of hourly deviation of 1.1-1.5 degrees between actual heat index and heat index as calculated from estimated temperature and estimated humidity. The following table summarizes how well the estimated heat index matches the actual heat index at the three interior prison sites for Method 1:

Heat Index Models	Dorm A	Dorm C	Dorm D
R-square =	0.9632	0.9591	0.9552
MAD =	1.0681	1.4336	1.4100
IQR (lower) =	-0.8410	-1.1180	-1.0680
IQR (upper) =	0.7720	1.1210	1.0430
95% conf int (lower) =	-3.1480	-3.9110	-4.1710
95% conf int (upper) =	2.7660	3.7780	4.1200

For example:

- For Dorm A, the R-square for estimating the interior heat index is 0.9632. This can be interpreted as saying that the Brenham data can account for 96.32% of the heat index at Dorm A.
- For Dorm A, the MAD is 1.0681. This says that the average error in estimating the interior heat index is only 1.0681 degrees.
- For Dorm A, the IQR is -0.841 to 0.772. This says that half of the errors (actual heat index – estimated heat index) are between -0.841 and 0.772 degrees.
- For Dorm A, the 95 percent confidence interval for the errors is -3.148 to 2.766. This means that 95 percent of the errors are between -3.148 and 2.766 degrees.

If the relationship between Brenham data and interior prison data in the June 17-August 26 period is similar to that of the August 27-October 8 period, then one can expect similar accuracy in estimating interior prison conditions by using Method 1.

§18. The result of Method 1 analysis indicates that the actual heat index at the three interior prison sites can be accurately estimated by temperature and humidity at the Brenham airport, as explained in the preceding paragraphs.

Step 1: Method 2

§19. Like Method 1, Method 2 is also a multiple regression model. Since the heat index is calculated from temperature and humidity, and since temperature and humidity are both available at the three interior prison sites and at the Brenham airport, the heat index was calculated at all four sites for each hour in the period August 27-October 8 of mutual data availability. Then a modification of the regression model used in Method 1 was run to estimate the heat index directly at each of the three prison sites. For example, the form of the regression equation for estimating the heat index at Dorm A is

$$\begin{aligned} DormAHI_t = \; & \alpha + \beta_1 T_t + \beta_2 T_{t-1} + \beta_3 T_{t-2} + \beta_4 T_{t-3} + \beta_5 T_{t-4} + \gamma_1 H_t + \gamma_2 H_{t-1} + \gamma_3 H_{t-2} + \gamma_4 H_{t-3} + \gamma_5 H_{t-4} \\ & + \delta_1 I_1 + \delta_2 I_2 + \delta_3 I_3 + \cdots + \delta_{23} I_{23} + \gamma_1 H_t + \lambda_2 HI_{t-1} + \lambda_3 HI_{t-2} + \lambda_4 HI_{t-3} + \lambda_5 HI_{t-4} + \varepsilon_t \end{aligned}$$

The symbols have the same meaning as in Method 1, except that $DormAHI_t$ is the heat index in Dorm A at time *t*, $HI_t, HI_{t-1}, HI_{t-2}, HI_{t-3}, HI_{t-4}$ are correspondingly the Brenham heat index in the same and four preceding hours, and the coefficients $\lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5$ of these variables are additional parameters that the regression model estimates. The regression models for Dorm C heat index and Dorm D heat index have the same form, except for the replacement of $DormAHI_t$ by $DormCHI_t$ or $DormDHI_t$ as dependent variables on the left hand side of the equation. The numerical estimates of the parameters for the three regression equations of Method 2 are displayed in Table 2. Table 2 also displays numerical assessments of how well each equation works, including R-square, the mean absolute deviation (MAD), the inter-quartile range (IQR) and 95 percent confidence intervals for the deviation. These numerical assessments, as shown in Table 2, show that each regression equation works very well. The R-squares are consistently very high, and MAD consistently low. Graphical evidence of the good correspondence between estimates and actual data is provided in Figures 14-16, as discussed in the following paragraphs.

§20. Figures 14-16 show overlays of the regression model estimates of hourly heat index on the actual hourly heat index at each of the three prison sites for the period August 27-October 8 of mutual data availability. The regression models each have R-squares of about 95% and average magnitude of hourly deviation between actual and estimated heat index of 1.2-1.5 degrees. For example:

- For Dorm A, the R-square for estimating the interior heat index is 0.9570. This can be interpreted as saying that the Brenham data can account for 95.70% of the heat index at Dorm A.
- For Dorm A, the MAD is 1.1984. This says that the average error in estimating the interior heat index is only 1.1984 degrees.
- For Dorm A, the IQR is -0.9732 to 0.9771. This says that half of the errors (actual heat index – estimated heat index) are between -0.9732 and 0.9771 degrees.
- For Dorm A, the 95 percent confidence interval for the errors is -3.3328 to 3.1237. This means that 95 percent of the errors are between -3.3328 and 3.1237 degrees.

If the relationship between Brenham data and interior prison data in the June 17-August 26 period is similar to that of the August 27-October 8 period, then one can expect similar accuracy in estimating interior prison conditions by using Method 2.

§21. The result of Method 2 analysis indicates that the actual heat index at the three interior prison sites can be accurately estimated by temperature, humidity, and the heat index at the Brenham airport, as explained in the preceding paragraphs.

Step 2: Estimating the Heat Index for the June 17-August 26 Period

§22. Estimating the Heat Index at the Three Prison Sites for Early Summer, 2014

The second step in the analysis is to input the Brenham weather data for June 17 – August 26 into the first step equations in order to estimate what the measurements would have been at the interior prison sites for the period before prison site measurements commenced. Results for the first step in the analysis (see §10-§21) have indicated that both Methods 1 and 2 can accurately estimate the heat index at the three prison sites from the temperature, humidity, and heat index at the Brenham airport for the period August 27-October 8 of mutual data

availability. If the relationship between the temperature, humidity, and heat index at the three interior prison sites and the Brenham remains substantially similar for the earlier period June 17-August 27, then the equations that were developed in the first step for the later period should also apply to estimate the heat index at the three interior prison sites with similar accuracy for the earlier time period when only the data from the Brenham airport are available. This report explicitly makes that assumption.

§23. The equations developed for both Method 1 and Method 2 were used to estimate the hourly heat index at each of the three prison sites for the period June 17-August 26. The Brenham temperature, humidity, and/or heat index data for June 17-August 26 were plugged into the Method 1 and Method 2 equations, using the parameter estimates displayed in Tables 1 and 2. Then the results of Method 1 and Method 2 were compared at each prison site. Figures 17-19 show overlays of the hourly estimates using the first step equations for Method 1 and for Method 2 at each of the three prison sites for the period June 17-August 26. The overlays have R-squares of approximately 99% for the correspondence and average magnitude of hourly deviation of about 0.5 degrees between the two Methods. From this, it is apparent that there is substantial agreement between the two Methods in their estimates of the heat index at the three prison sites for June 17-August 26. Given the analysis, one may expect similar accuracy in estimating the hourly heat index at the three prison sites for the period June 17-August 26 before measurements commenced in the prison as was actually achieved for the period August 27-October 8 after measurements became available at the prison sites. One may expect similar values for June 17-August 26 for R-square, MAD, IQR and 95 percent confidence intervals as shown in Tables 1 and 2 for August 27-October 8.

§24. Table 3 shows the estimated heat index obtained from Method 1 for each of the three prison sites for each hour in the period June 17-August 26, 2014. Table 4 shows the estimated heat index obtained from Method 2 for each of the three prison sites for each hour in the period June 17-August 26, 2014.

I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct.

Executed this 21st day of May 2015, in Austin, Texas.

Thomas W. Sager

Thomas W. Sager, PhD

Figure 1. Hourly temperature at three prison sites and the Brenham airport, August 27-October 8

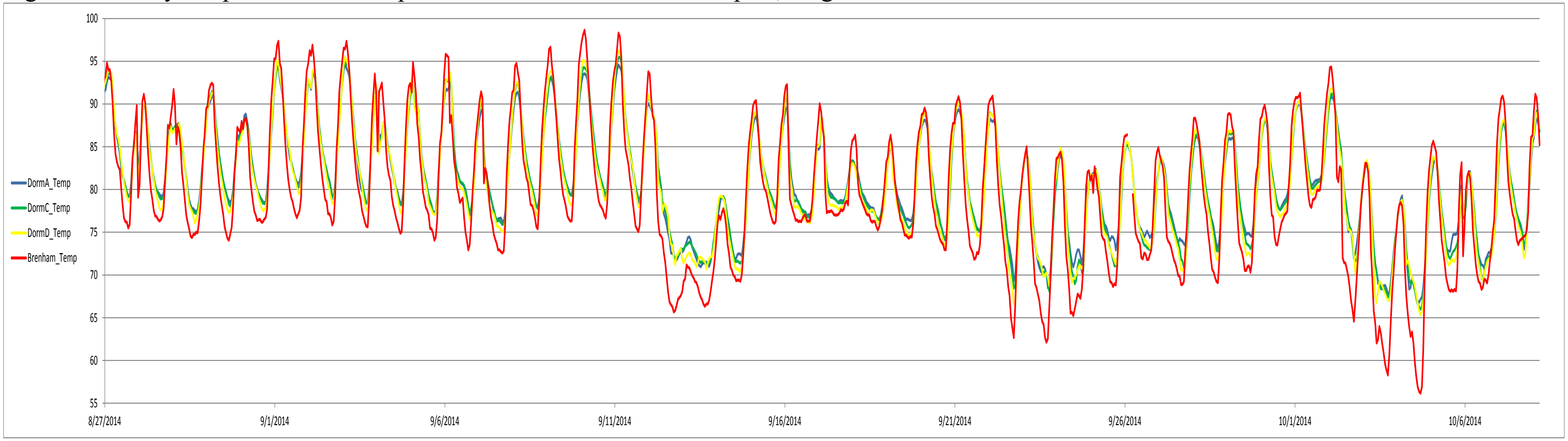

Figure 2. Hourly humidity at three prison sites and the Brenham airport, August 27-October 8

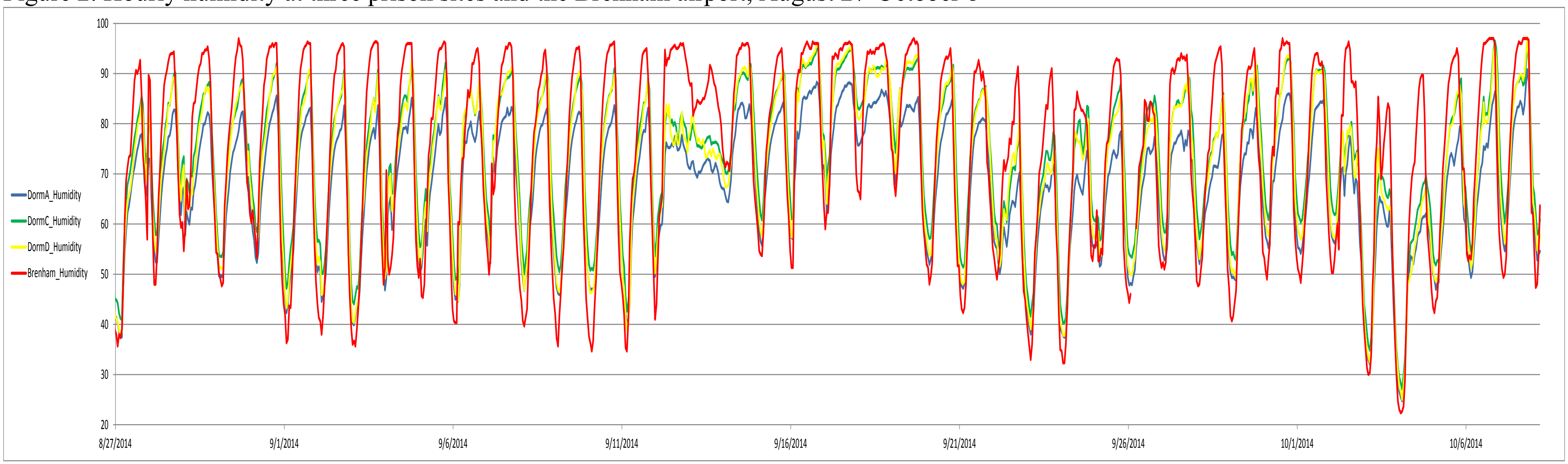

Figure 3. Hourly temperature at the Brenham airport, June 17-August 26

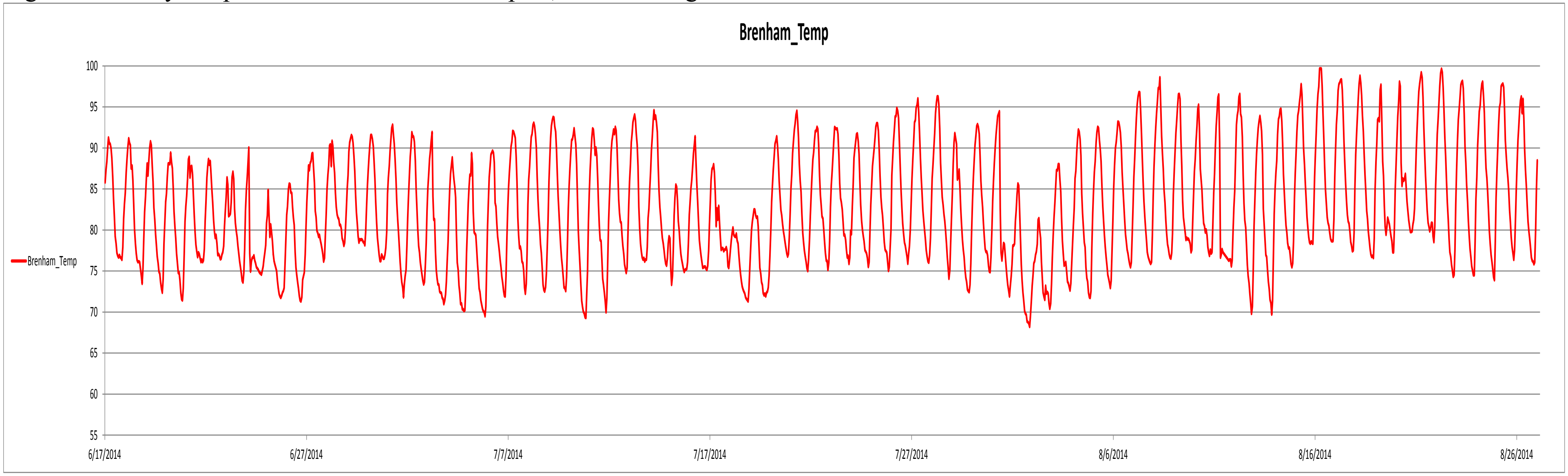

Figure 4. Hourly humidity at the Brenham airport, June 17-August 26

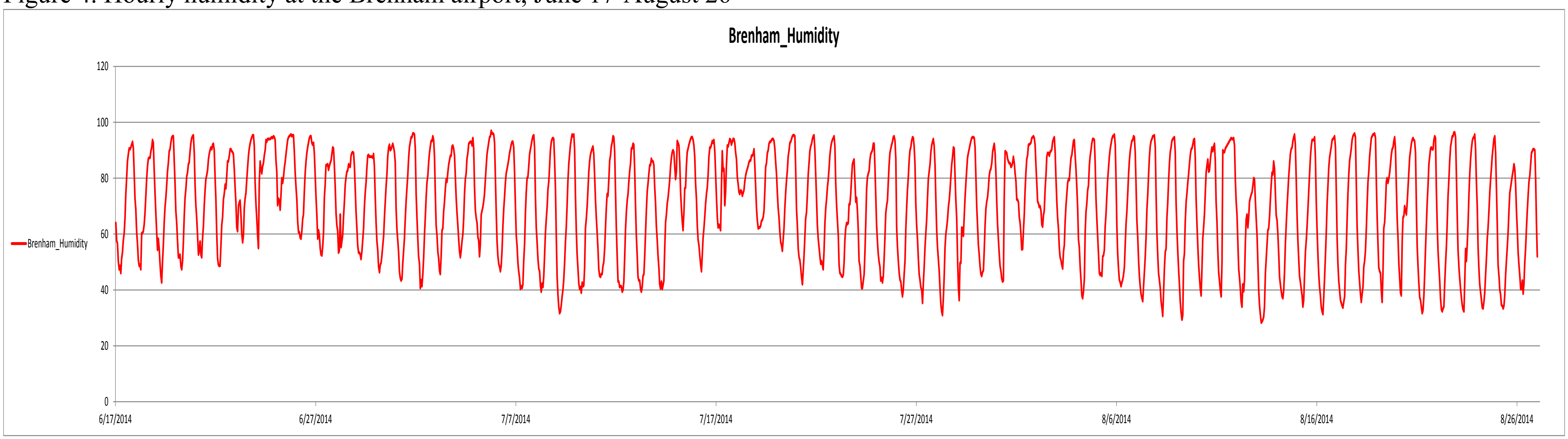

Figure 5. Method 1 estimates of temperature at Dorm A prison site, overlaying actual temperatures, August 27-October 8

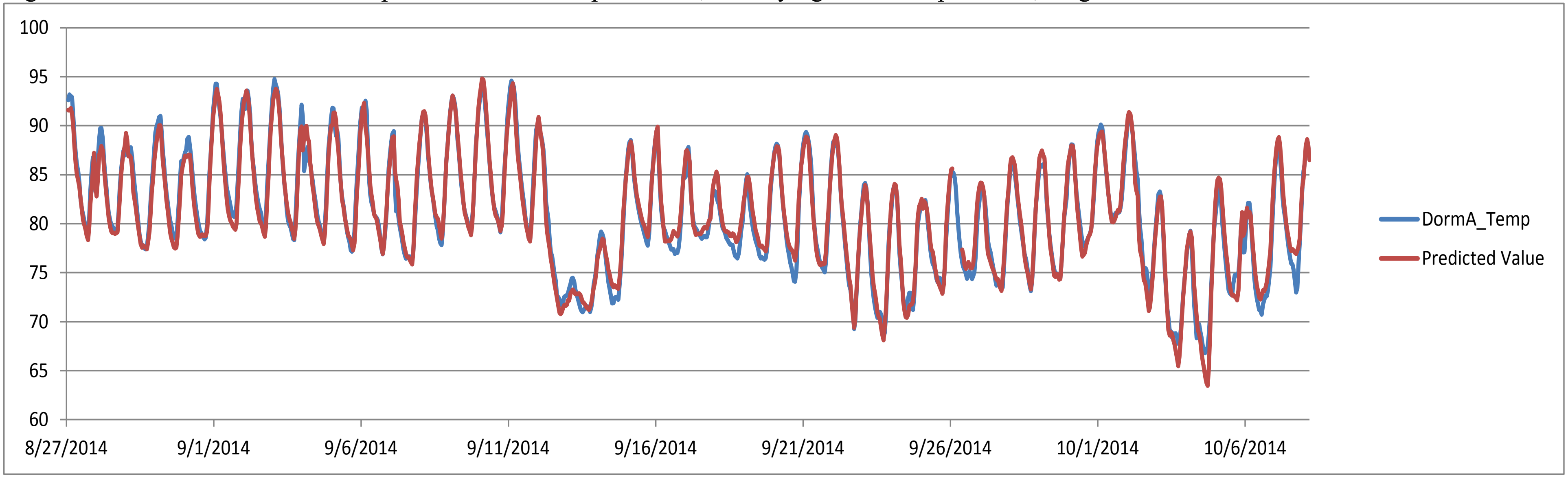

Figure 6. Method 1 estimates of temperature at Dorm C prison site, overlaying actual temperatures, August 27-October 8

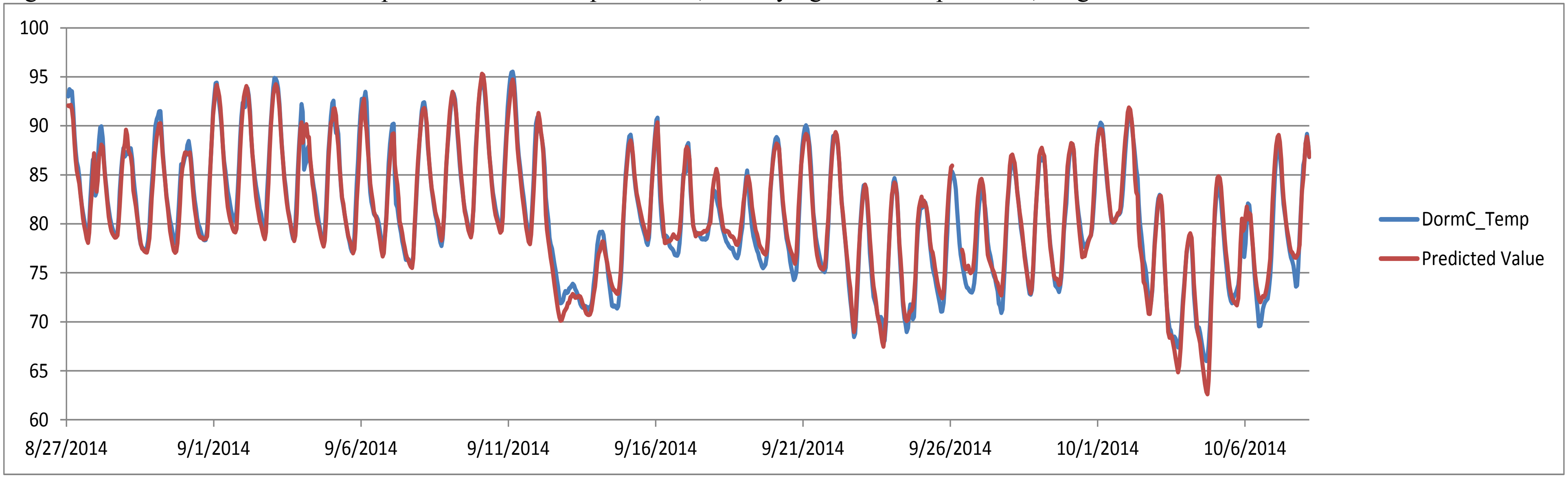

Figure 7. Method 1 estimates of temperature at Dorm D prison site, overlaying actual temperatures, August 27-October 8

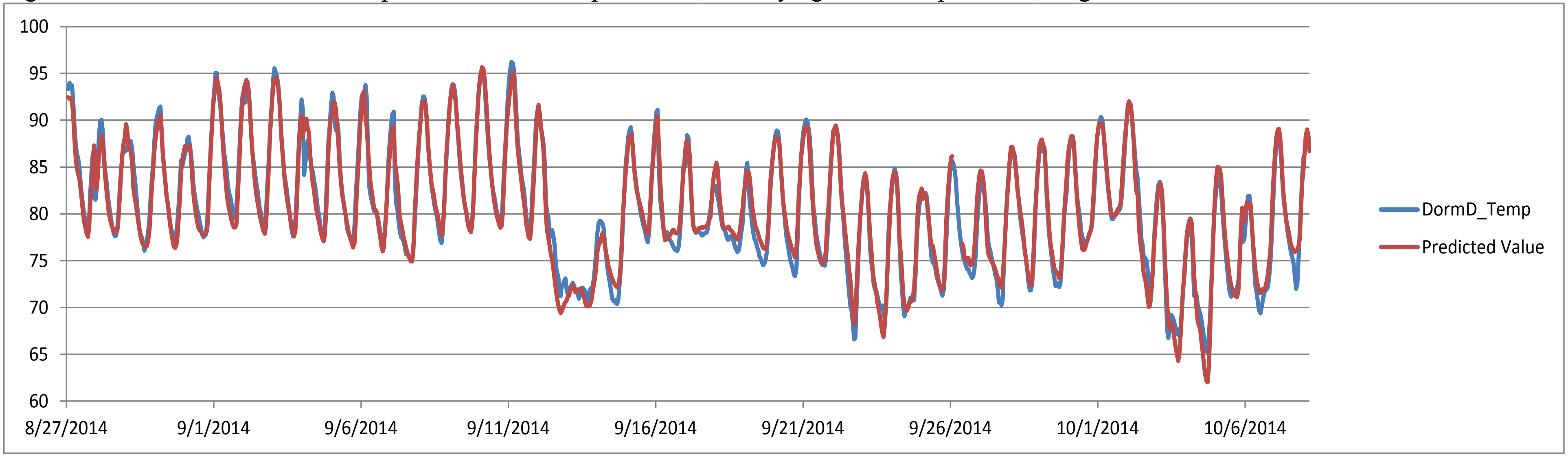

Figure 8. Method 1 estimates of humidity at Dorm A prison site, overlaying actual humidity, August 27-October 8

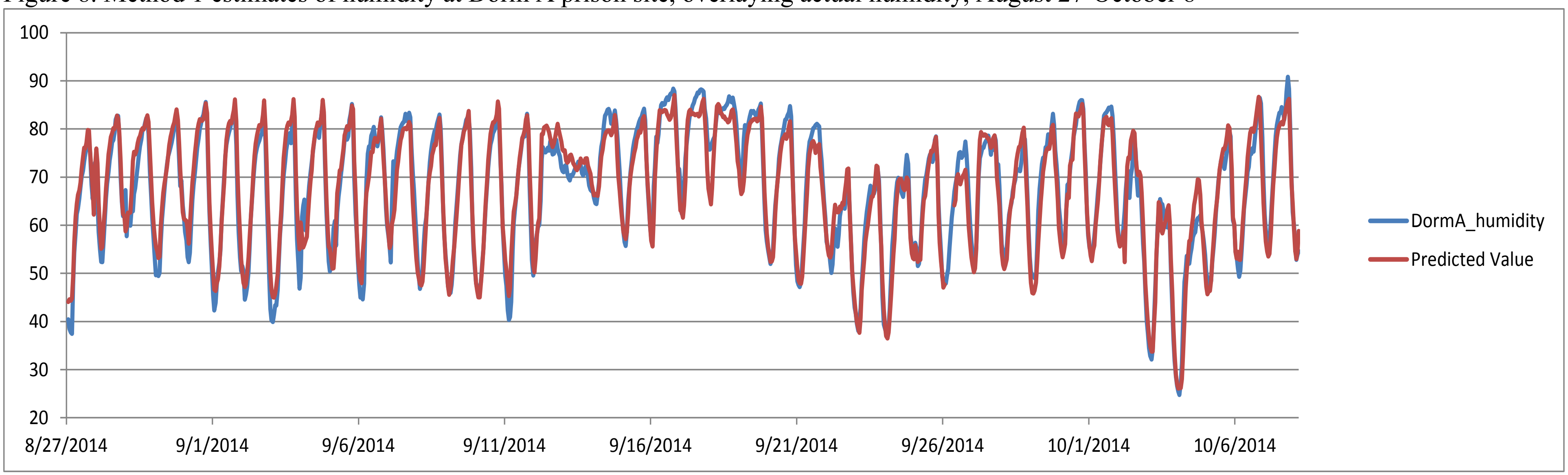

Figure 9. Method 1 estimates of humidity at Dorm C prison site, overlaying actual humidity, August 27-October 8

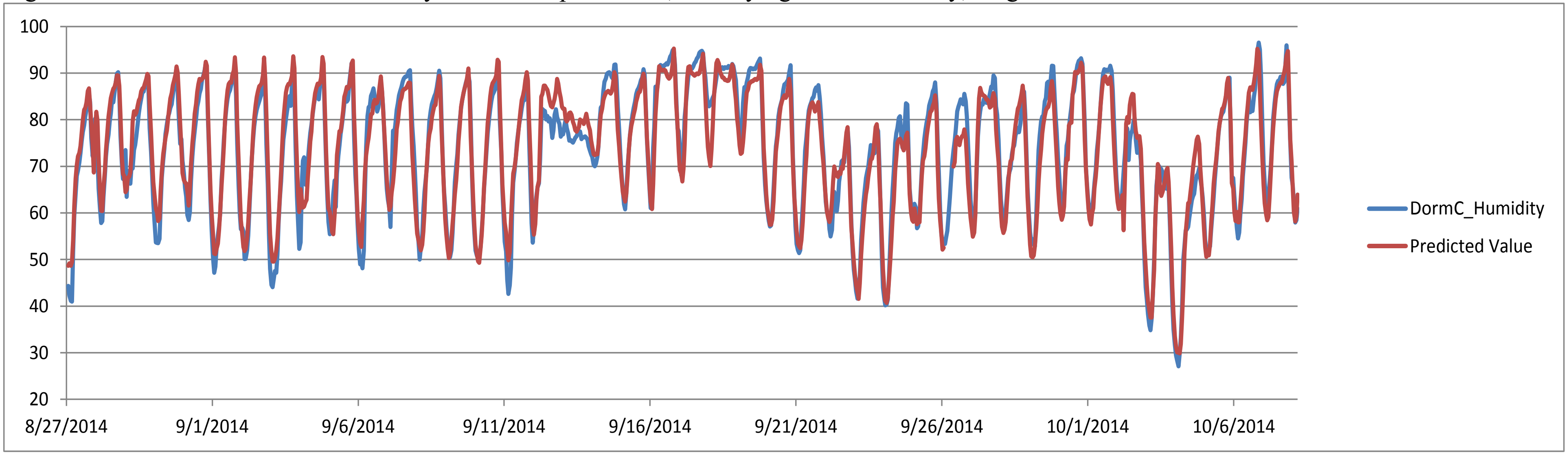

Figure 10. Method 1 estimates of humidity at Dorm D prison site, overlaying actual humidity, August 27-October 8

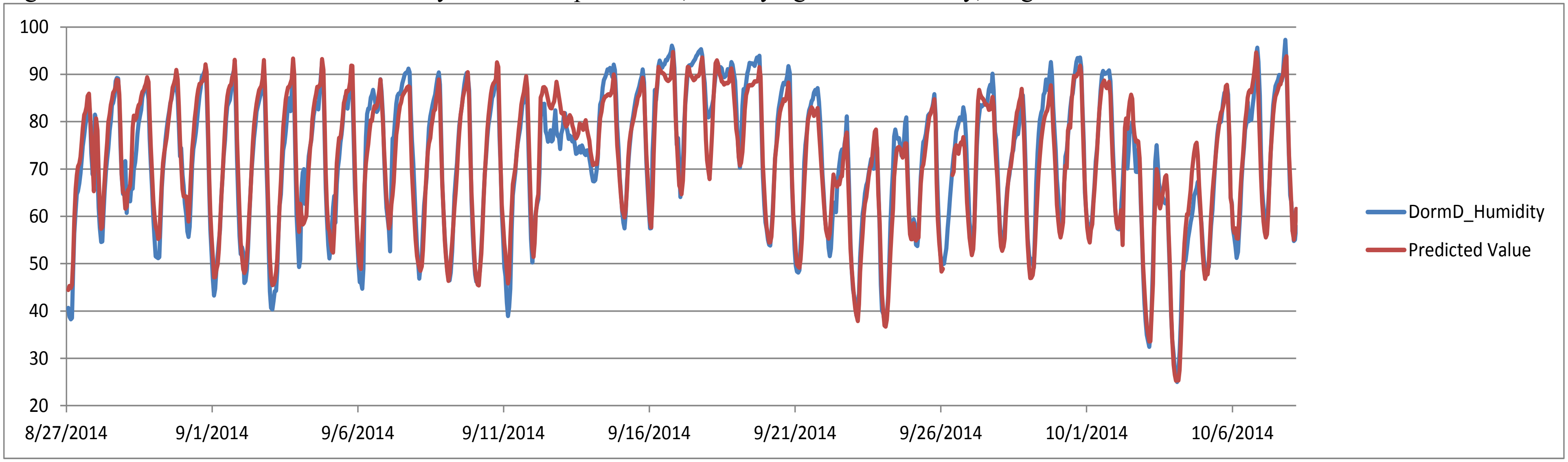

Figure 11. Method 1 estimates of hourly heat index at Dorm A prison site, overlaying actual heat index, August 27-October 8

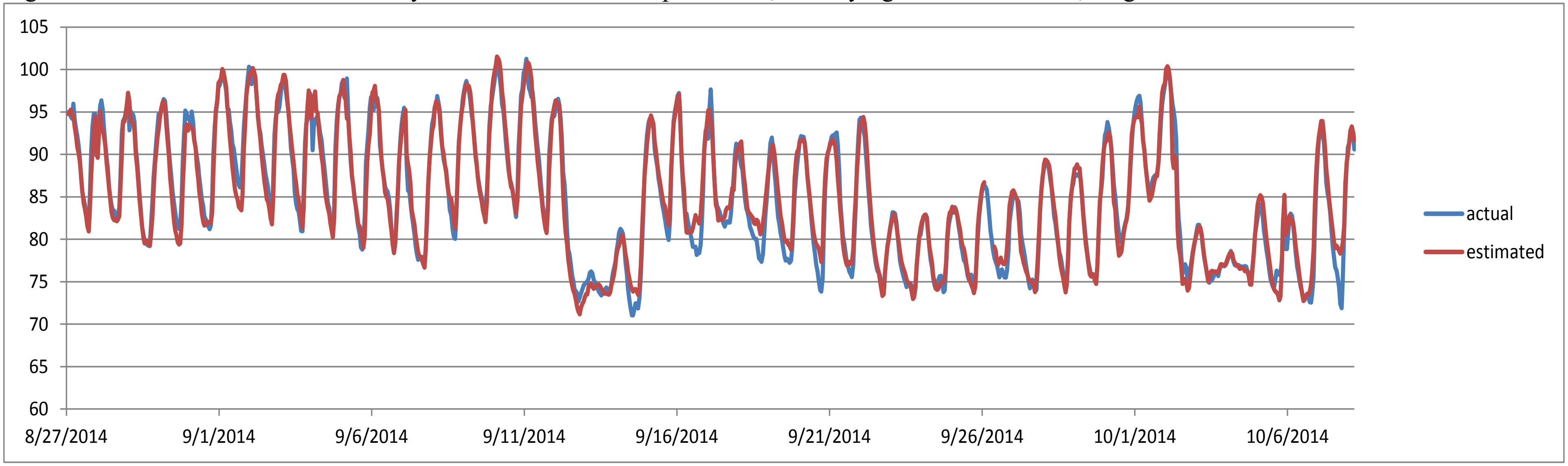

Figure 12. Method 1 estimates of hourly heat index at Dorm C prison site, overlaying actual heat index, August 27-October 8

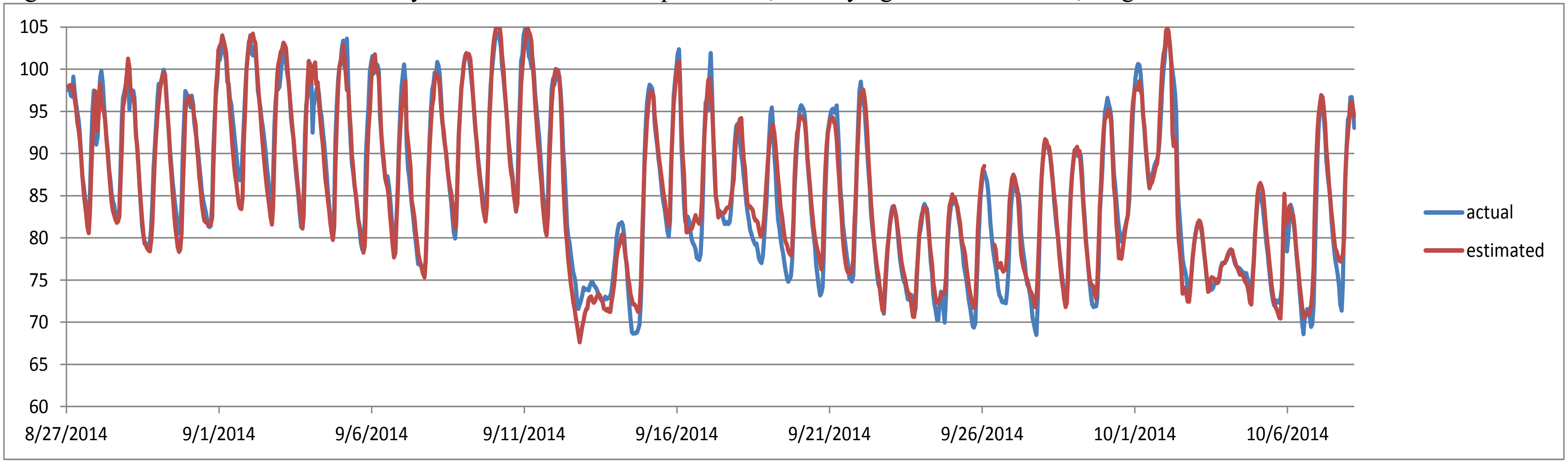

Figure 13. Method 1 estimates of hourly heat index at Dorm D prison site, overlaying actual heat index, August 27-October 8

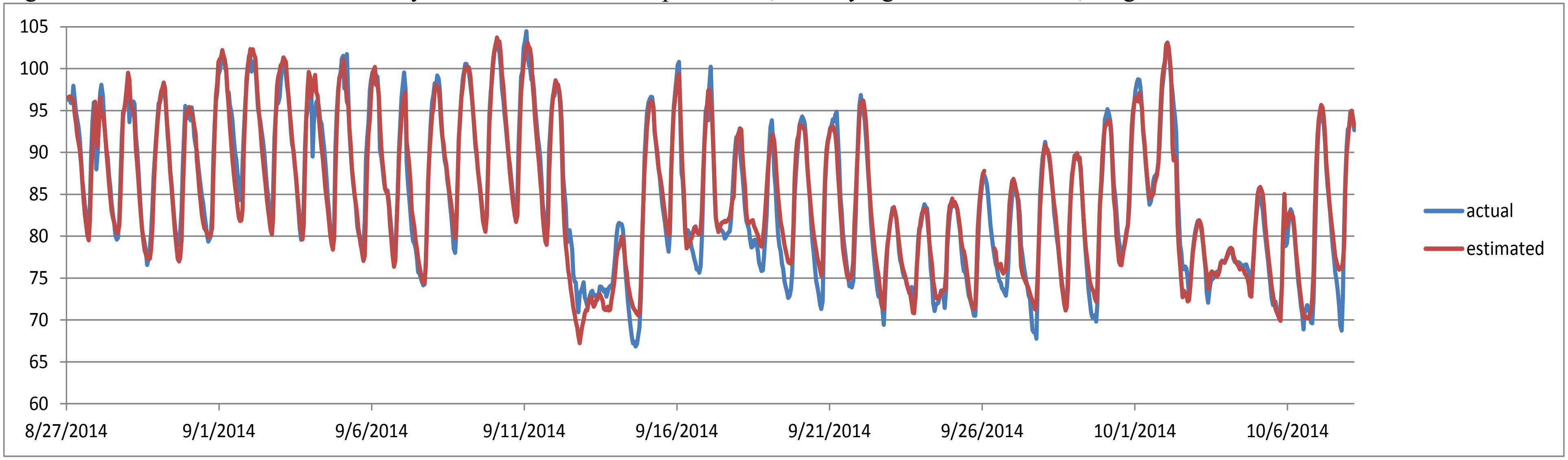

Figure 14. Method 2 estimates of hourly heat index at Dorm A prison site, overlaying actual heat index, August 27-October 8

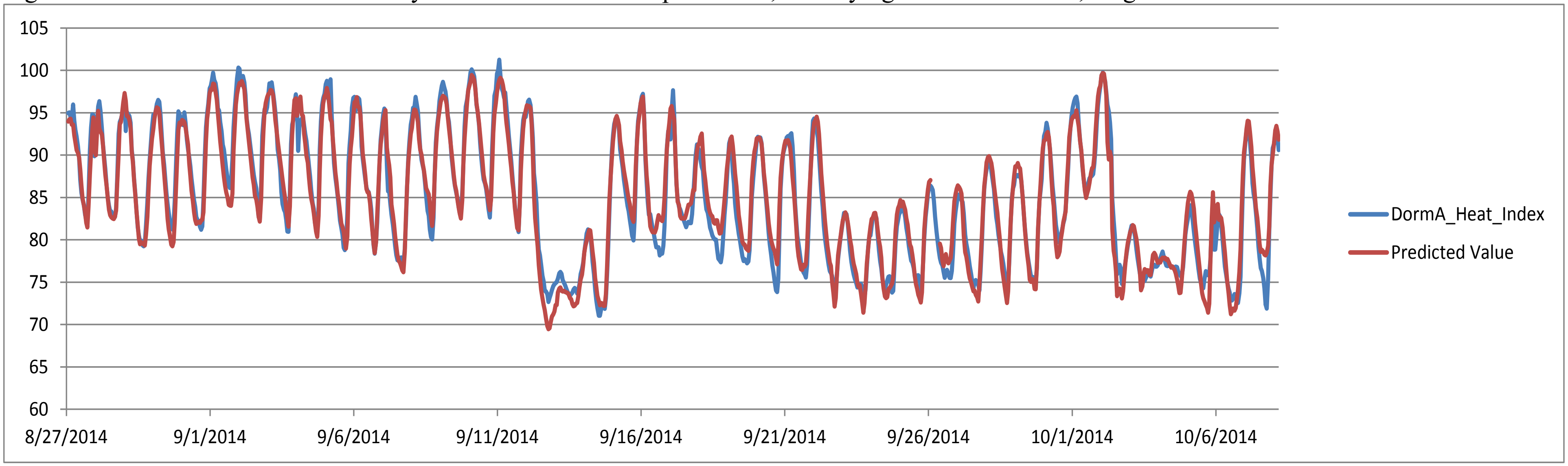

Figure 15. Method 2 estimates of hourly heat index at Dorm C prison site, overlaying actual heat index, August 27-October 8

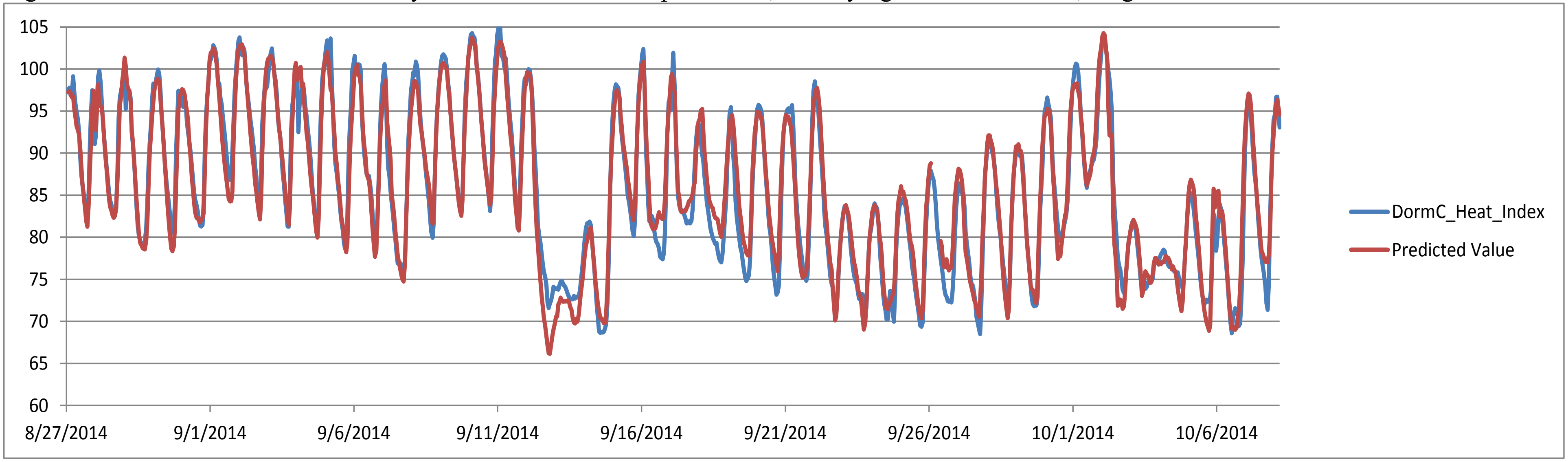

Figure 16. Method 2 estimates of hourly heat index at Dorm D prison site, overlaying actual heat index, August 27-October 8

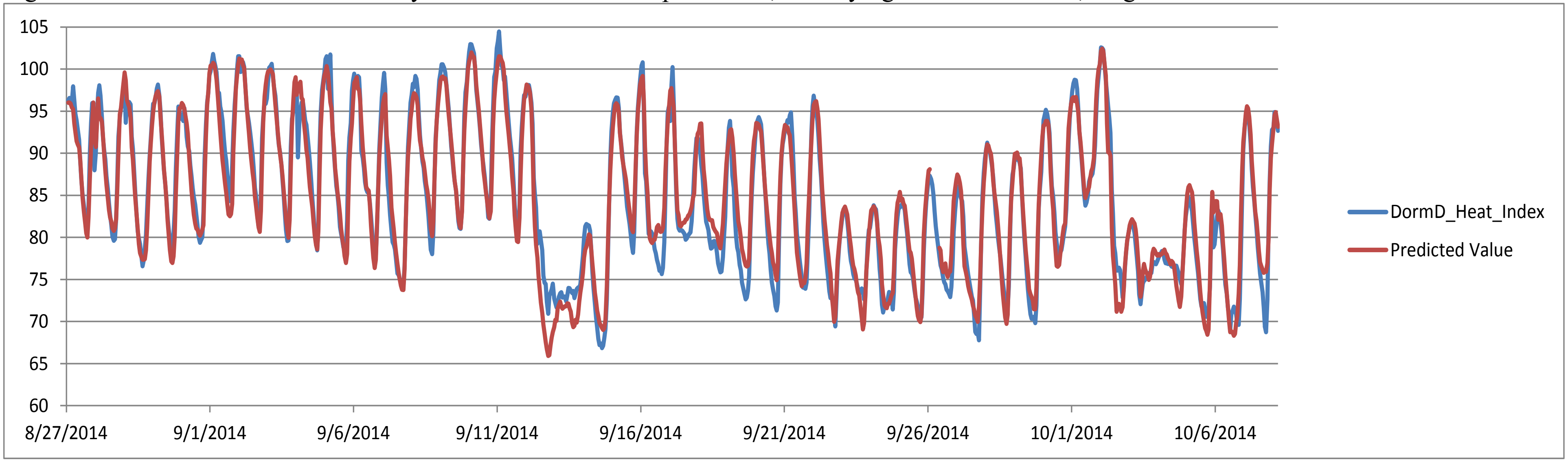

Figure 17. Method 1 and Method 2 overlays of estimated hourly heat index at Dorm A prison site, June 17-August 26

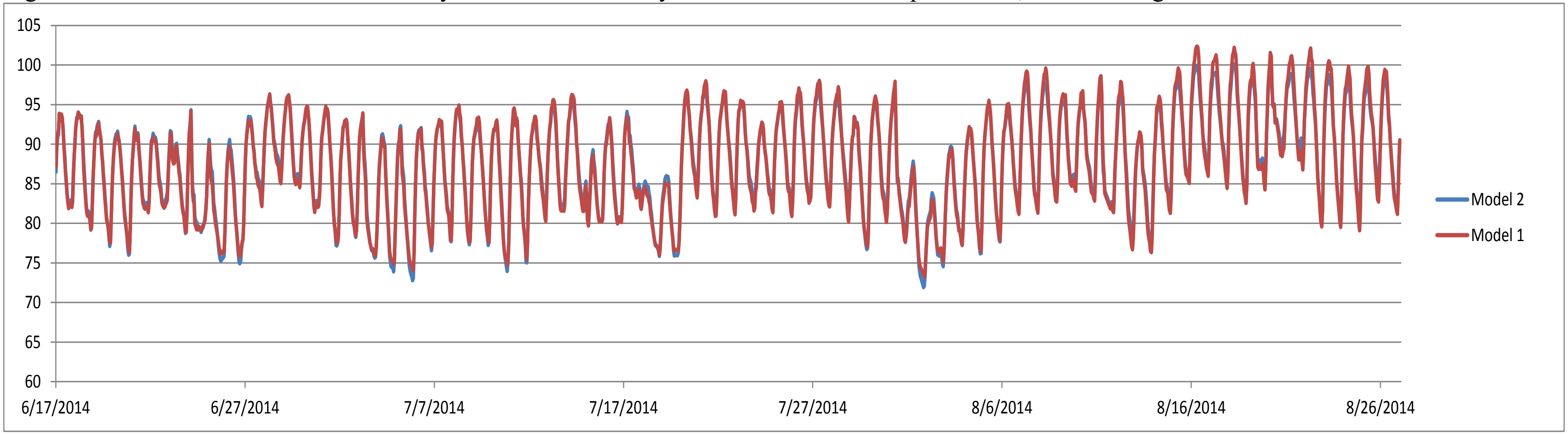

Figure 18. Method 1 and Method 2 overlays of estimated hourly heat index at Dorm C prison site, June 17-August 26

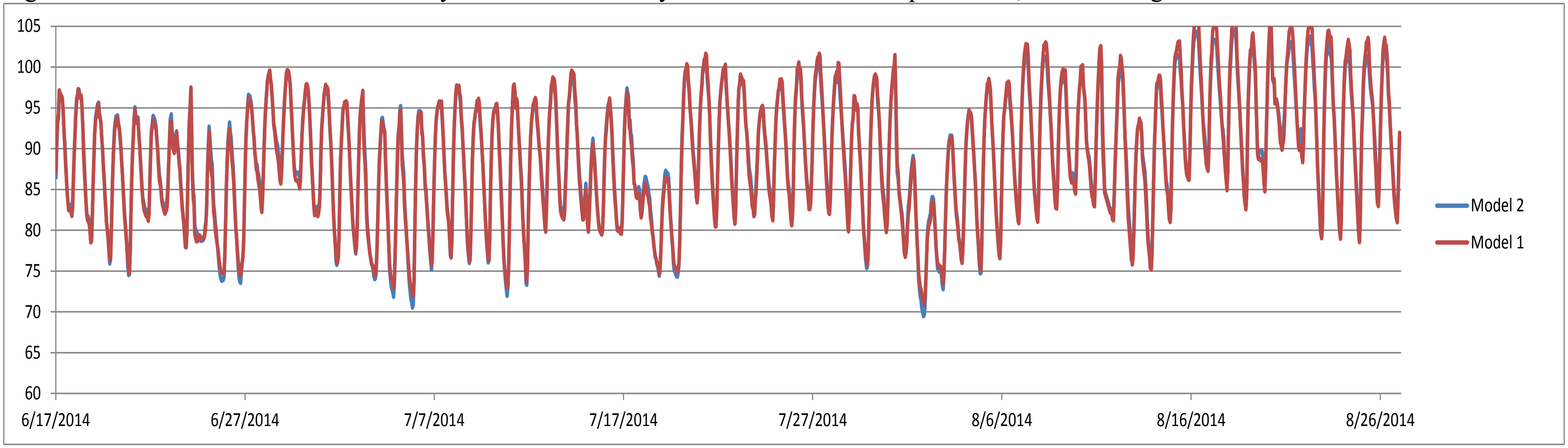

Figure 19. Method 1 and Method 2 overlays of estimated hourly heat index at Dorm D prison site, June 17-August 26

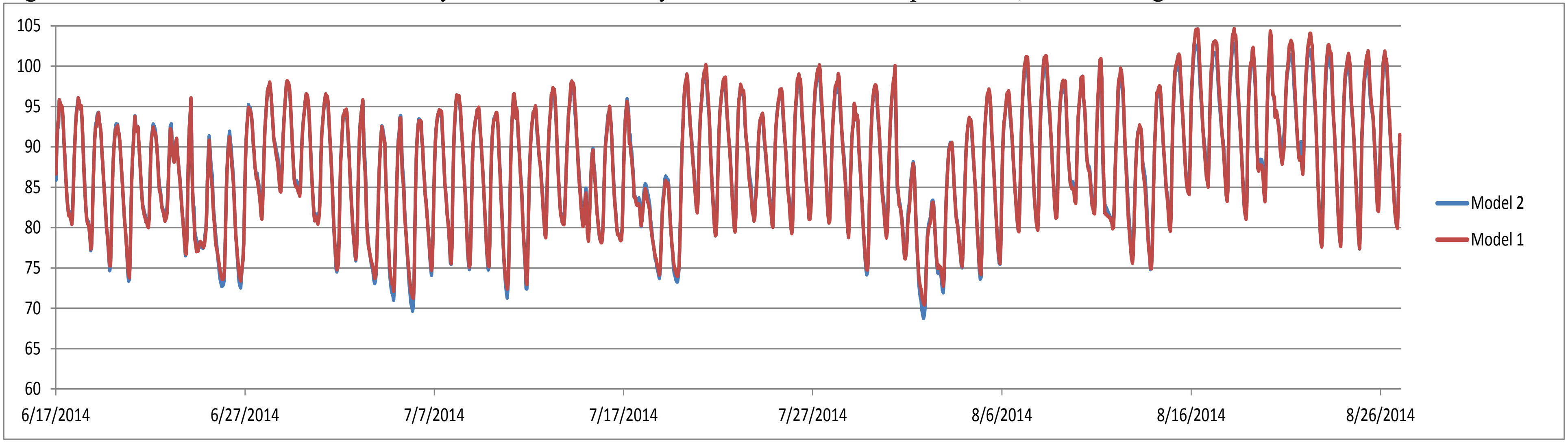

Exhibit 2

Report of Susi Vassallo, M.D., F.A.C.E.P., F.A.C.M.T.

Table of Contents

I. Introduction

A. Background, Qualifications, and Experience

1. My name is Susi Vassallo. I am a physician licensed to practice medicine in the states of Texas and New York. My curriculum vitae is attached hereto as Exhibit A.

2. I have been retained by counsel for Plaintiffs to serve as an expert in the case of *Bailey et al. v. Livingston et al.*, No. 14-cv-01698 (KPE) (S.D. Tex. filed June 18, 2014). Specifically, I have been retained to render an opinion about the conditions of confinement at the Texas Department of Criminal Justice ("TDCJ") prison known as the Wallace Pack Unit ("Pack Unit") in Navasota, Texas, and the relationship of these conditions to the risks of heat stroke and heat-related disorders for inmates at the Pack Unit.

3. I am board certified in Emergency Medicine and Medical Toxicology. I practice Emergency Medicine and care for patients with a broad range of medical problems of both chronic and acute. I have twenty-five years of experience in caring for prisoners and victims of heat stroke and heat-related disorders. I have been on the faculty of the New York University School of Medicine/ Bellevue Hospital Center since 1987. My areas of special focus in teaching and writing include thermoregulation and the effects of drugs and illnesses on thermoregulation. A list of my publications is contained in my curriculum vitae.

4. I have provided expert reports and testimony on issues relating to heat in prisons and jails for over ten years in federal courts, as detailed in my curriculum vitae. I was qualified as an expert on the effects of heat on prisoners in federal courts in Louisiana, Mississippi, and New York, among others. A list of these cases is contained in my curriculum vitae.

5. I have lectured nationally and internationally on topics concerning thermoregulation and heat-related disorders. I am frequently asked to provide assistance to journalists and reporters writing on heat stroke and the prevention of heat stroke. A list of selected presentations and lectures is contained in my curriculum vitae.

6. I am a certified correctional health professional. Bellevue Hospital Emergency Department, where I work as an emergency room physician, is the primary receiving hospital for the male prisoners of New York City jails.

7. I also practice at the University Medical Center Brackenridge Hospital in Austin, Texas where I hold the position of Volunteer Clinical Faculty of Emergency Medicine at the Dell Medical School and Attending Physician in Emergency Medicine.

B. Materials Reviewed

8. To prepare this report, I reviewed the following documents:

a. The Plaintiffs' amended complaint in this lawsuit;

b. TDCJ Administrative Directive 10.64, "Temperature Extremes in the TDCJ Workplace," November 10, 2008;

c. TDCJ Correctional Managed Health Care Policy Manual Section D-27.2, "Heat Stress," October 15, 2012;

d. Prison medical records for Plaintiffs Keith Cole, Jackie Brannum, Fred Wallace, Ray Wilson, Richard King, Dean Mojica, and Marvin Yates, as produced by the medical provider for Pack Unit, University of Texas Medical Branch ("UTMB");

f. Pack Unit heat incident reports, including reports of injuries to officers and inmates;

g. The list of "heat sensitive" inmates generated for use in "wellness checks";

h. The rule 30(b)(6) depositions of Lannette Linthicum, Karen Hall, and Robert Herrera;

i. The depositions of Robert Herrera and Fausto Avila;

j. Temperatures and humidity information for the summer of 2014 at the Pack Unit, based on the Report of Professor Tom Sager;

k. Autopsies of prisoners who died of heat stroke in TDCJ custody; and,

l. "Heat audits" conducted at the Pack Unit.

9. I understand that discovery is continuing in this case. My opinions are preliminary, and I reserve the right to amend these opinions based on additional information learned through discovery.

10. In this report, I provide opinions about thermoregulation, heat-related disorders, and the impact of prolonged exposure to high heat indexes on the human body. I also provide opinions

about the increased risk of heat stroke and heat-related disorders from prolonged exposure to high heat indexes, for people with certain medical conditions, people taking certain medications, and people over the age of 65. The lists of medical conditions and medications contained in this declaration are meant to be illustrative, not exhaustive.

11. The opinions contained in this declaration are based on my training, clinical experience, and familiarity with the extensive body of medical literature on the subjects of thermoregulation and the effects of drugs, illness, and age on thermoregulation. I have attached to this declaration as Exhibit B a short bibliography of some of the most important articles and studies on which I rely to form my conclusions. All of my opinions are rendered to a reasonable degree of medical certainty.

II. Thermoregulation in the Human Body

A. Why the Body Needs to Thermoregulate

12. Thermoregulation is the process by which the human body maintains its temperature within a safe physiologic range in response to internal and external thermal stimuli. The body's safe physiologic range is typically a set point of + or – 0.8 range of 98.6 degrees Fahrenheit.

13. Thermoregulation is a major bodily process. Inability to thermoregulate properly impairs the function of multiple bodily systems, including but not limited to the nervous system, pulmonary system, cardiovascular system, gastrointestinal system, and endocrine and kidney function.

14. Heat transfers in and out of the body at all times through four processes – radiation, convection, conduction, and evaporation. Radiation is heat transfer through emission of particles or waves, such as hot cement. Convection is heat transfer by moving a liquid or gas, such as hot air blowing over the skin. Conduction is heat transfer through direct contact between the body and other surfaces, such as a hot stove. Evaporation is heat loss when water changes from liquid to a vapor, such as drying sweat.

15. The body's temperature may rise as a result of exposure to high or prolonged external heat. A number of external factors such as high temperature, humidity, radiant heat and wind speed may cause a rise in body temperature. Radiant heat sources include not only the sun, but also the walls of buildings, the cement grounds, or hot objects in direct contact with the body, that increase heat by conduction.

B. How Thermoregulation Works

16. The hypothalamus is the main part of the brain responsible for thermoregulation. Thermoreceptors—for example, nerves in the skin—detect changes in body or blood temperature. The hypothalamus directs the body's responses to these changes.

17. The body uses two primary mechanisms to cool itself—perspiration (sweating) and cutaneous vasodilation (dilation of blood vessels close to the skin), both of which facilitate heat dissipation. Both of these processes are critical to effective thermoregulation. Sweating requires sweat gland function, a process requiring neurotransmission. Cutaneous vasodilation brings heated blood close to the skin, transferring heat from the body's core to the surface. Vasodilation likewise is dependent on adequate neurotransmission. Adequate cardiac output is essential to the process. When the body needs to emit heat, the heart pumps faster and harder in order to pump more blood to the skin. Heat dissipates from the body's surface, primarily through evaporation. Evaporation is the process of vaporization of water or sweat and is responsible for large amounts of heat loss from the skin. Perspiration, or sweating, brings water to the skin, where it evaporates and causes heat to dissipate from the body. Medical conditions and pharmaceutical agents may impair these critical processes.

18. When the external environment gets hotter and more humid, the body works harder to cool itself by increasing vasodilation and perspiration. The heart also increases its cardiac output. In normal conditions, 0.5 liters of blood circulate to the skin per minute. In a hotter and more humid environment, 5-20 liters of blood must circulate per minute in order for the body to cool. The heart pumps faster and harder in order to pump more blood through the body to maintain blood pressure and cooling. Ultimately the need to maintain blood pressure results in a limitation in vasodilation and the body accumulates heat.

19. The act of sweating depletes the body of water and salt, and without adequate repletion, a person will become dehydrated. Dehydration can cause light-headedness or dizziness, a lack of energy, low blood pressure, weakness, and increased heart rate. A person who is dehydrated and salt-depleted may be unable to increase cardiac output any further. If fluids are not replaced, core temperature will rise, and hyperthermia may result. Hyperthermia occurs when so much heat accumulates in the body that the body's natural thermoregulatory processes are overwhelmed and fail.

20. Moreover, evaporation becomes less effective as humidity rises in the external environment. When the external environment has high relative humidity, the air is already saturated with moisture. High humidity makes it more difficult for the water from sweat to evaporate from the surface of the skin into the air. Therefore, the body cannot engage in

evaporative cooling as efficiently. As a result, the body cannot release as much heat, and body temperature may continue to rise, possibly leading to hyperthermia.

21. Scientists measure air temperature and humidity together using a formula, and the resulting figure is called the "heat index." The heat index is a better indication of how the body "feels" heat than air temperature alone.

III. Medical Emergencies that Result from Extreme Heat and Hyperthermia

22. The term "heat stress" refers to environmental conditions that cause the body's thermoregulatory systems to fully engage. As discussed above, "hyperthermia" refers to elevated body temperature due to failed thermoregulation, which occurs when the body accumulates more heat than it can dissipate.

A. Heat-Related Disorders Cause Significant Pain and Suffering

23. Heat-related disorders occur when the body's temperature control system is overloaded, and the body is unable to adequately dissipate heat. The risk for heat stroke and other heat-related disorders increases sharply when the heat index exceeds 88 degrees Fahrenheit.

24. Heat-related disorders include heat syncope (fainting), heat cramps, heat exhaustion and heat stroke.

25. Heat syncope is a brief loss of consciousness or collapse that results from heat exposure. It results from the increased demand on the heart to pump blood to the skin for cooling. The heart is so taxed that it is not able to pump enough blood to cool the body, generate adequate blood pressure, and provide blood to the brain to maintain consciousness and stay upright. As a result, a person may suffer a sudden, brief loss of consciousness.

26. Heat cramps are painful muscle cramps that result from heat exposure. Heat cramps occur due to dehydration and sodium depletion, most often as a result of exercising or working in a high-heat index environment. Heat cramps can occur in the legs, and they can be very painful. The cramps can persist for hours, even after a person drinks water and takes rest.

27. Heat exhaustion is a disorder that results when heat stress begins to overwhelm the body. The hypothalamus directs the body to maintain a normal body temperature, the heart beats maximally, and the body sweats maximally, but thermoregulation still fails. The body temperature begins to elevate. A person suffering from heat exhaustion may feel chilled even though they know that it is hot. They can also feel light-headed, thirsty, nauseous, very weak,

faint, or dizzy. Their pulse and heart beat are very rapid, and they may also experience muscle aches (myalgias), headache, or abdominal cramps. A person suffering from heat exhaustion may try to lie down in order to conserve energy and help elevate blood pressure. If the person does not get out of the heat, heat exhaustion can lead to heat stroke.

28. There is overlap in heat-related disorders. Heat exhaustion may include heat cramps and heat syncope, or weakness, fatigue, and nausea. Medical providers should always remove people experiencing these problems from a hot environment in order to prevent heat stroke.

B. Heat Stroke is the Most Serious Heat-Related Medical Emergency

29. The most severe and potentially fatal heat disorder is heat stroke, a severe medical emergency caused by persistent heat stress. Heat stroke is defined as an elevation of body temperature above 105.5 degrees Fahrenheit, along with an alteration of mental status. The altered mental status could be subtle, manifesting as inappropriate behavior or impaired judgment, or it could include confusion, delirium, stupor, coma, or convulsions.

30. Heat stroke can occur whether or not a person is engaged in physical activity. There are two kinds of heat stroke: exertional and classical. Exertional heat stroke occurs when a person is exercising or engaged in physically strenuous activity in a hot and humid environment. Classical heat stroke, however, is not associated with exercise. It occurs simply because of prolonged exposure to a high-heat index environment. Classical heat stroke commonly occurs during heat waves, and victims include persons least able to tolerate heat or escape from heat, such as infants, older adults, individuals with psychiatric disorders, and chronically ill persons.

31. Heat stroke is deadly. Very high body temperatures in heat stroke can damage the brain and other vital organs. Signs and symptoms of heat stroke include vomiting, weakness, headache, bloody diarrhea, irritability, bleeding, and altered mental status. In heat stroke, heat stress causes an inflammatory progression. Heat causes tissue injury, and cells in the body's organs begin to die, ultimately causing multiple organ systems to fail.

32. Heat stroke comes on rapidly. Heat stroke is not necessarily preceded by other heat-related disorders such as heat cramps or heat exhaustion. The body's temperature rises rapidly, and collapse may occur very quickly, with little or no warning. In just ten or twenty minutes, a person suffering from heat stroke will have life-threatening manifestations such as seizure.

33. Heat stroke comes on with little warning. Two-thirds of heat stroke victims experience symptoms for less than one day before being hospitalized or being found dead. Some victims go to sleep apparently well and are found the next day critically ill or dead. A person who begins to

suffer from heat stroke may be unable to call for help because of altered mental status. Heat stroke can occur in persons who have never complained about heat related conditions before. The rapid onset of heat stroke has important implications: even frequent observations of persons at high risk of heat stroke are unlikely to give adequate warning of impending collapse

34. Heat stroke is a true medical emergency. It can cause death or permanent disability if emergency treatment is not provided. When a patient begins to suffer from heat stroke, they must immediately receive medical treatment, or they are put at increased risk of death or serious injury. Survival is possible if cooling measures are properly instituted.

35. Heat stroke carries a significant risk of death and permanent disability. Studies have shown heat stroke mortality rates ranging from 30-80%. Survivors of heat stroke may have significant heat-related morbidity, such as permanent inability to walk and talk. Permanent neurological damage occurs in up to 17% of survivors. Permanent neurological damage can include phrenic nerve damage, leading to trouble with spontaneous breathing, and structural damage to the cerebellum, which causes balance and walking problems, or cognitive problems.

36. Signs of less serious heat-related disorders may portend heat stroke. Published studies show that recent heat-related symptoms such as thirst, weakness, nausea, and dehydration are precipitating factors for heat stroke. Other conditions, such as fatigue associated with a recent deficit in sleep, poor physical conditioning, a recent febrile illness (fever), extensive skin conditions including burns, scleroderma or psoriasis and obesity, are also precipitating factors for heat stroke.

37. Individuals with chronic illnesses such as coronary artery disease, hypertension, or diabetes, obesity, are much more likely to succumb to heat stroke when under heat stress.

38. When a person is experiencing heat stroke, the proper emergency medical treatment requires rapid and aggressive cooling, typically by submerging the body in ice. Water should be poured on the person. Other treatment, including respiratory support with a respirator, and treatment for cardiac dysrhythmias, bleeding, electrolyte abnormalities, kidney failure, rhabdomyolysis, seizures and altered mental status, including fluid replacement, will be provided as necessary.

C. Persistent Exposure to Extreme Heat Brings On Other Medical Events

39. There are multiple epidemiological studies that demonstrate increased numbers of deaths from underlying medical conditions under times of extreme heat. In terms of pure numbers, this is a much greater threat to the well- being of a population. Many more people die each year from heat-induced exacerbations of underlying medical vulnerabilities than die from heatstroke. Persistent exposure to extreme heat also brings on medical events or exacerbates medical conditions that are not traditionally thought of as "heat related." For example, in extremely hot environments, people who suffer from cardiovascular disease are more prone to morbidity and mortality. People with diabetes may suffer acute complications such as electrolyte and fluid abnormalities and exacerbation of the coexistant cardiovascular complications that result from diabetes. People with respiratory ailments such as asthma are more prone to suffer an acute asthma attack. People with kidney ailments are more prone to suffer from acute kidney injury. These medical events cause pain and suffering and can lead to permanent injury.

IV. Heat Stroke and Other Heat-Related Disorders Are Entirely Preventable

40. Heat stroke and heat-related disorders are entirely preventable. Keeping people out of extreme heat is sufficient to prevent all heat-related disorders.

41. The risks of extreme heat are well known to the medical establishment and to health care providers.

42. Living in a sufficiently cool environment can prevent all cases of classical heat stroke. Classical heat stroke is most common among those who have no access to air conditioning during heat waves. Studies have shown that access to air conditioning significantly reduces heat-related morbidity and mortality.

43. Studies of heat waves show that air conditioning is not a luxury but a lifesaver, especially for individuals at heightened risk for heat-related disorders. Fully 91% of heat stroke victims found at home did not have a working air conditioner. Having a working air conditioner was associated with an 80% reduction in the risk of death due to heat and cardiovascular disease and a 66% reduction in mortality due to cardiovascular disease.

44. The CDC (Centers for Disease Control and Prevention) recommends that people who cannot afford air conditioning in their homes should spend as much time as possible each day during hot weather in an air-conditioned environment because it will reduce the risk of heat-related disorder.

IV. Persistent Exposure to Extreme Heat Poses a Serious Health Risk for All Inmates at the Pack Unit

45. All of the inmates at the Wallace Pack Unit, including young healthy men with no known medical problems, are at substantial risk for serious heat-related disorders during periods of persistent exposure to a heat index above 88 degrees Fahrenheit.

46. Scientific studies have shown that the incidence of heat-related illnesses and deaths increase starting at heat index numbers in the mid to high 80s. Studies including studies of the Chicago heat wave in 1995, and the European heat wave of 2003 and others, have shed great light on the danger posed by extremely high heat indexes during a period of prolonged exposure.

47. Studies show that death from all causes increases during periods of prolonged heat stress, even in young, seemingly healthy people. There is a continuum of risk. Although prolonged exposure to extreme heat is a cause or primary contributing factor, these deaths often are not identified as heat-related by medical providers because they do not result from heat stroke.

48. Epidemiological studies of heat waves also reveal that although some young, healthy people with no known medical problems will tolerate heat stress more easily than the sick or elderly, during heat waves, mortality in the general population (and not just the sick or elderly) increases, and the number of illnesses in the general population (and not just the sick or elderly) increases. This means that young, healthy people are also at risk of heat-related disorders during periods of prolonged heat stress.

49. Young, healthy people do not always recognize symptoms of heat-related disorders and take the steps necessary to prevent heat stroke. Heat stroke can occur suddenly without warning. The signs and symptoms leading to heat stroke vary among individuals. Young, healthy people may ignore symptoms of heat exhaustion because they overestimate their physical strength, or fail to realize that heat can be deadly for them, and not only for elderly and sick people. Young, healthy people may fail to take adequate precautions as a result. Therefore, they are at substantial risk of heat-related disorders during periods of prolonged exposure to heat indexes above 88.

50. In addition, young people who believe they are healthy may not in fact be healthy. Many people have undiagnosed cardiovascular disease, and cardiovascular disease increases the risk for heat-related disorders. For example, based on my experience as an emergency medicine specialist, it is not uncommon to see patients, including young men, who do not know that they have hypertension until they present to the emergency department for any of many reasons and have vital signs obtained in the course of their medical assessment.

51. Mitigating the health risk from extreme heat requires people to be proactive about their health. It is essential for people to seek a cool environment at the first signs of a heat-related disorder.

52. Any competent medical provider who learns that a patient is living in an extremely hot environment would advise the patient to get into an air conditioned or significantly cooler environment for as much time as possible, in order to mitigate the dangers associated with living in an environment with a heat index above 88 degrees Fahrenheit such as in the Pack Unit.

53. All of the inmates at the Pack Unit are at substantial risk of serious heat-related disorders because of their prolonged exposure to heat indexes above 88. It is my understanding based on review of the report of Professor Tom Sager that the heat indexes in the Pack Unit inmate housing areas during summer months fall into the danger or extreme danger ranges according to the heat chart and exceed 88 for prolonged periods. This intense heat undoubtedly worsens the health of the prisoners.

54. All of the inmates at the Pack Unit are at risk of heat-related disorders because, in addition to the exposure to high heat indexes, they are unable to access some precautionary measures by virtue of their incarceration. First and foremost, they do not have the ability to sit in air conditioning whenever they need it. This is by far the most effective measure for preventing heat-related disorders.

55. All of the inmates confined at the Pack Unit are exposed to a heat index of 88 or higher on most of the days of the summer and for prolonged periods of time. They lack regular access to an air-conditioned or significantly cooler environment.

56. It is my opinion, based on my training, experience, and familiarity with the extensive body of medical literature on the subject of thermoregulation, heat illness and the effect of environmental heat on medical conditions, that all of the inmates at the Pack Unit are at a substantial and unreasonable risk of heat stroke and heat-related illness. In a persistent high-heat environment such as the Pack Unit, even prisoners without any known underlying medical conditions are at significant risk of suffering from serious heat-related disorders.

57. Lowering the temperature to 88 degrees indoors does not completely eliminate the risk of heat-related illness or injury. Heat-related illness or injury is possible at lower temperatures. For example, an officer suffered heat exhaustion at the Pack Unit when the heat index was only 86. A temperature above 88 degrees, however, is unreasonable, and unacceptably increases the risk to human health and welfare.

V. Persistent Heat Stress Places Heat-Sensitive Inmates at the Pack Unit at Even Greater Health Risk

58. It is well accepted in the medical literature that certain people are at greater risk of heat-related disorders as a result of persistent heat stress. These people include: a) persons with illnesses or medical conditions that impair thermoregulation; b) persons taking drugs or medications that impair thermoregulation; and c) adults over the age of 65.

59. In addition, it is clear from the medical literature that persons who are socially isolated are at increased risk of heat-related disorders during periods of persistent heat stress.

60. As explained below, Pack Unit inmates who are over the age of 65, or who have medical conditions or take medications that make them less heat tolerant, are at even greater risk of heat stroke and heat-related disorders.

A. Extreme Heat Poses an Even Greater Health Risk to Inmates at Pack with Medical Conditions That Impair Thermoregulation

61. As discussed above, certain medical conditions greatly increase the risk for heat stroke and other heat-related disorders. Heart disease, respiratory diseases such as asthma and chronic obstructive pulmonary disease, and diabetes are some of the most common such conditions.

62. People with heart disease are at increased risk of heat stroke and heat-related disorders. Cardiovascular disease, refers to a number of problems relating to the heart, brain and blood vessels. The most common form is coronary artery disease, in which plaque build-up in arteries (called atherosclerosis) that causes blockages, and can lead to heart attacks or strokes. For a person suffering from heart disease, the heart is not able to function maximally when it is called upon to do so.

63. In the case of heat stress, the heart is called on to circulate blood, and to circulate more blood and to do it more quickly. All cooling mechanisms depend on having adequate intravascular volume (in blood, plasma, and water), and the ability to pump those fluids around the body and particularly to the skin is very important. An average person at rest circulates 5L of blood per minute around the body. With heat stress, that circulation can go up to 20L per minute. To respond to heat stress, the heart must beat faster (heart rate) and harder (stroke volume), squeezing out more blood (cardiac output) with each pump (the cardiac output is equal to the stroke volume multiplied by the heart rate).

64. Many different cardiovascular problems can reduce cardiac output, including, chronic hypertension, arteriosclerosis causing blood vessels to dilate inadequately. Arteriosclerosis is due to advanced age, previous smoking, diet, high cholesterol, or high lipids in the blood (hyperlipidemia) or diabetes.

65. Diabetes sufferers also are at increased risk of heat stroke and heat-related disorders. Diabetes is a chronic disease caused by insulin imbalance or decreased insulin sensitivity. Diabetes causes microcirculatory changes that result in blood vessels that are unable to dilate adequately and unable to deliver sufficient blood and nutrients to the body. Diabetes compromises the circulation to the brain and the heart. Diabetes impairs the ability to sweat and impairs the ability of the cardiovascular system to respond to heat.

66. Diabetes may also impair kidney function, and the kidneys' ability to maintain salt-water balance is an important part of the body's response to heat stress.

67. Hypertension sufferers likewise are at greater risk of heat stroke and heat-related disorders. Blood pressure is a measure of the force of the blood pushing against the blood vessels. Hypertension, or high blood pressure, is a condition where the heart is being forced to pump harder because of the hardening of the arteries (atherosclerosis).

68. Persons with hypertension have blood vessels that have abnormal compliance. In other words, the elasticity and the ability of the blood vessels to open and close are decreased. This predisposes to heat illness.

69. People with pulmonary diseases, such as chronic obstructive pulmonary disease (COPD) and asthma, are at increased risk of heat stroke and heat related disorder. People with diseased lungs have problems with oxygenation and ventilation. For example, people with COPD have limited ability to exchange gases within the lungs, and their ability to oxygenate the body is decreased. Any stressor to the lungs will worsen their underlying conditions. People with sleep apnea have disordered sleep and develop cardiovascular disease. These conditions make people susceptible to illnesses precipitated by excessive environmental heat.

70. Asthma is a chronic inflammation that causes obstruction of the airways. Breathing in hot, humid air can trigger asthma symptoms such as consistent coughing. Asthma is worsened in hot conditions. The scientific literature is replete with evidence that pollutants are worse in hot weather. These exacerbate asthma. Additionally, persons with asthma have lung dysfunction that leads to impaired exchange of gases.

71. Spinal cord injury also leads to heat susceptibility. Temperature regulation signals from the hypothalamus in the brain are sent through the spinal cord to the body. If the spinal cord is not functioning normally, the ability to thermoregulate is impaired.

B. Extreme Heat Poses an Even Greater Health Risk to Inmates at Pack with Medical Conditions That Impair Their Ability to Reason

72. People with dementia or psychiatric disease are at increased risk of heat stroke and heat-related disorders because they may have impaired behavioral responses to heat stress. A person suffering from heat disorder must be able to express himself, and have mental energy and interpersonal skills to ask for help.

73. Dementia sufferers cannot problem-solve, and their ability to reason is affected.

74. Persons who suffer from depression or anxiety – two very common diagnoses – may be unable to communicate well with others, or they may experience apathy and inability to take on and overcome challenging circumstances, during times of physiologic heat stress

75. People with mental illness may not have the ability to reason or help themselves during a period of heat stress, because their illness may adversely affect their mood, thinking, or behavior.

C. Extreme Heat Poses an Even Greater Health Risk to Inmates at Pack Taking Medications that Impair Thermoregulation

76. Medications that impair the ability of the body to dissipate heat, or interfere with salt and water balance, increase the risk for heat-related disorders. There are several classes of these drugs.

77. Medications that impair vasodilation and sweating – the primary processes of thermoregulation – will place persons at greater risk of heat stroke and heat-related disorders.

78. Drugs that depress cardiac function impair cardiac output and place persons at greater risk of heat stroke and heat-related illness. Common drugs used to prevent or treat cardiovascular disease, known as Beta blockers, calcium channel blockers and diuretics, all fall into this category. Beta blockers and calcium channel blockers impair the heart’s ability to squeeze and reduce the speed at which the heart beats, thereby lowering cardiac output.

79. Diuretics, such as hydrochlorothiazide, place patients at substantially increased risk of heat stroke. They are commonly prescribed for persons suffering from hypertension. Diuretics

remove salt and water from the body in order to decrease blood pressure. In so doing, diuretics reduce the amount of blood volume circulating in the body and impair the ability of the heart to increase cardiac output. When cardiac output is reduced during heat stress, there is a greater risk of heat stroke.

80. Sympathomimetic drugs cause narrowing of the blood vessels, or vasoconstriction. Vasoconstriction results in decreased blood flow to the skin, inhibiting the loss of heat from the body. Examples of sympathomimetic drugs include common nasal decongestants and over the counter cold remedies. Sympathomimetic drugs have been associated with heat stroke in numerous reports.

81. Drugs with anticholinergic properties cause sweat gland dysfunction. Sweat glands work through the neurotransmitter called acetylcholine; anticholinergic drugs block the action of this neurotransmitter. Many drugs have anticholinergic properties, including drugs used to treat mental illness, itching, and gastrointestinal disorders. Examples of drugs having an anticholinergic effect include antihistamines, cyclic antidepressants, phenothiazines (i.e. Thorazine) and butyrophenones (i.e. Haldol). Phenothiazines and butyrophenones are also called neuroleptics or tranquilizers.

82. In addition to their anticholinergic effects, the phenothiazines and butyrophenones further impair thermoregulation by interfering with the hypothalamus, the part of the brain that regulates temperature. In other words, the body's thermostat is broken. This results in disruption of signals from the brain, further impairing sweating and vasodilation, as well as other heat loss responses.

83. Selective Serotonin Reuptake inhibitors (SSRI's) likewise interfere with cooling. SSRI's are anti-depressants prescribed for people suffering from depression. One of the major pieces of thermoregulation occurs in the brain. The hypothalamus requires serotonin, as well as other chemicals, to work properly and direct thermoregulation. That is the area where SSRI's work, and they decrease the ability of the hypothalamus to respond to and regulate the body's temperature.

D. Extreme Heat Poses an Even Greater Health Risk to Inmates at Pack Over Age 65

84. People over the age of 65 are at increased risk of heat related disorder and heat stroke. Of the 8,015 heat-related deaths in the general population reported by the CDC over a 20 year period, 45% of deaths occurred in persons over the age of 65. The risk of heat stroke was 10-12 times greater for these individuals.

85. In a July 2006 report, the CDC found that for 3,401 deaths (out of a total of 3,442 deaths) for whom age information was available, 7% were less than 15 years old, 53% were aged between 15-64 years old, and 40% were aged over 65.

86. People over the age of 65 are more likely to have the chronic medical conditions, such as heart disease or diabetes, that place them at increased risk of heat stroke and heat-related disorders. They are also more likely to take the medications that adversely affect the body's ability to thermoregulate, thereby placing them at increased risk of heat stroke and heat-related disorders.

87. Even healthy people over the age of 65 who do not suffer chronic medical conditions or take those medications are at greater risk of heat stroke and heat-related disorders. Age is associated with a reduction in aerobic capacity, an important factor in the ability of the body to respond to heat stress. After peaking at about age 20 years, the aerobic capacity declines about 10% each decade after age 30, less in people who have maintained a high degree of physical fitness. Older adults simply cannot increase their heart rates as much as younger people and as a result, their hearts will not perform as well during periods of heat stress.

88. Aging is also associated with other physiologic changes that modify the body's response to heat. People over the age of 65 cannot sweat as well as younger people, and their ability to vasodilate may also be reduced. Finally, older adults may not sense high heat or thirst as acutely, and therefore may fail to properly hydrate or take other measures.

89. The Texas Department of Criminal Justice recognizes that the foregoing categories of medical conditions, medications, and ages put people at greater risk of heat stroke and other heat-related disorders. In its "Correctional Managed Health Care Policy Manual," Section D-27.2 (entitled "Heat Stress"), TDCJ provides guidelines to prevent and treat "heat stress illness." Attachment A to that policy guideline lists a number of medical conditions that render a person at greater risk of heat-related disorders, as "Co-Morbidities that May Affect Heat Tolerance." The medical conditions listed there correctly include some of the conditions described above. In addition, the TDCJ list correctly includes age over 65 as a co-morbidity that affects heat tolerance. Attachment B to that policy guideline lists a number of "Drugs Associated with Heat Stress." The drugs listed there correctly include some of the drugs described above. TDCJ cautions personnel to consider co-morbidities and drugs in limiting work assignments for prisoners, however they do no such thing as regards to housing.

VI. Review of Named Plaintiffs' Prison Medical Records

A. Plaintiff Marvin Yates

90. Marvin Yates is a named plaintiff in this case. I reviewed medical records regarding Mr. Yates that were produced to plaintiffs in this litigation. Based on my review of these documents, I make the following findings and conclusions.

91. Mr. Yates has the following medical conditions according to his medical records: hypertension, hyperlipidemia (high triglycerides), and non-insulin dependent diabetes mellitus. He also has coronary atherosclerosis, and in August 2012, he had two stents placed. Stents are placed into the arteries that serve as conduits for blood and oxygen to be delivered to the heart muscle. He also has chronic obstructive pulmonary disease (Bates 3291), hepatitis C (Bates 3480), and psoriasis (Bates 3358). He has a history of sinusitis treated with septal nasoplasty (Bates 3401) and recurrent bronchitis (Bates 3414). Mr. Yates also has had prostate cancer treated with gold seeds implantation. (Bates 3427/ 3472).

92. As explained above, patients with hypertension are at greater risk of heat-related illness when exposed for long periods to extreme heat. Hypertension causes blood vessels to lose compliance (more rigid blood vessels), and adverse effects on heart structure Thus hypertension limits the body's ability to respond to the heat by pumping blood harder to the body.

93. Patients with diabetes are at greater risk of heat-related illness when exposed for long periods to extreme heat. Diabetes sufferers are prone to heat stress because they have micro-vascular abnormalities, because diabetes impairs circulation of the little arteries (called arterioles). People with diabetes have heart attacks because the coronary arteries that provide blood to the heart muscle have been adversely affected.

94. Patients with COPD (chronic obstructive pulmonary disease) are at greater risk of heat-related illness when exposed for long periods to extreme heat

95. Mr. Yates has psoriasis, an autoimmune disease that manifests as a long-lasting skin disorder.. Skin diseases, when extensive, can impair thermoregulation by interfering with sweat gland function.

96. Mr. Yates takes aspirin, as a preventative for heart disease. Aspirin keeps platelets from aggregating or attaching on to the artery. He takes Clopidigrel (Plavix), which also acts to impair platelets from attaching to the walls of the arteries and arterioles. This is prescribed in order to prevent heart attacks and strokes for people with a history of cardiovascular disease.

97. He takes Furosemide (Lasix, a diuretic). As explained above, diuretics reduce the amount of blood volume circulating in the body and impair the ability of the heart to increase cardiac output. When cardiac output is reduced during heat stress, there is a greater risk of heat stroke.

98. He takes Metoprolol, which is a beta adrenergic antagonist, also known as a beta blocker. As explained above, Beta blockers impair the heart's ability to squeeze and reduce the speed at which the heart beats, thereby lowering cardiac output.

99. He takes potassium supplementation, which is to counter the diuretics. He takes omeprazole, used to protect the gut from gastritis, perhaps because of his aspirin intake. He has a steroid inhaler for asthma (Qvar).

100. Medical records of Mr. Yates show a chronic care clinic note of July 23, 2011 (Bates 3300) that describes Mr. Yates as severely short of breath on that date. That day, the high temperature (without humidity) in Navasota was 100. On July 9, 2012 (Bates 3449), when the high temperature in Navasota was 91 (without humidity), another complaint was noted that he "sweats a lot." These symptoms could be due to heat-related illness.

101. On April 27, 2012, Mr. Yates presented with a blood pressure indicative of hypertension (159/89) and a chief complaint of dizziness, swelling of the lower extremities and fatigue with walking. (Bates 3453).

102. A medical record dated April 27, 2011 shows that Mr. Yates had difficulty with refilling his medications for his chronic conditions (Bates 3490). This was a recurrent theme in the charts that I reviewed. This results in lapses in control and treatment of the patient's chronic diseases.

103. The records reflect that Mr. Yates had several sick call requests related to the heat. Medical records in June 2012 shows that Mr. Yates had several sick call requests concerning the heat and his suffering as a result of the heat. On July 30, 2012 (Bates 4225, 4228), when the high temperature in Navasota was 91 degrees (without humidity), Mr. Yates said that he was being exposed to extreme heat and humidity and had been unable to get his heat sensitive work restriction reinstated. He also complained of chest pains and the need to take nitroglycerin on a third sick call in July.

104. In August 2011 Mr. Yates had more sick call requests complaining of the heat, breathing problems and chest pain. On August 18, 2011, when the temperature in Navasota was 104 (without humidity) he was called out due to this complaint. On August 25, 2011, when the temperature in Navasota was 98 (without humidity), he wrote that it was his fourth request for a work restriction due to heat and medical conditions.

105. Mr. Yates has active asthma. Based on his medical records, it appears that Mr. Yates had several incidents where his asthma was active. These dates include April 2014 (Bates 003195), September 27, 2013 (Bates 3205/ four times a day to clinic for treatment, for three days), December 28, 2012, with repeated visits for nebulizer treatment and injunctions for asthma on 12/5 and repeated visits ordered. He also went on 2/3/2013 with repeated nebulizer treatment. Respiratory disease is worsened in hot environmental conditions.

106. Based on a review of Mr. Yates's medical records, which provide information about his age, his medical conditions, and the medications he takes, it is my opinion that he is at extremely high risk of heat stroke or other serious heat-related illness as a result of the prolonged exposure to extremely high heat indexes in the inmate housing at the Pack Unit.

B. Plaintiff Keith Cole

107. Keith Cole is a named plaintiff in this case. I reviewed medical records regarding Mr. Cole that were produced to plaintiffs in this litigation. Based on my review of these documents, I make the following findings and conclusions.

108. Mr. Cole, has the following medical conditions according to his medical records: noninsulin dependent diabetes, hyperlipidemia (high fats in the blood), hypertension and coronary artery disease.

109. Patients with coronary artery disease have hardened arteries (also called atherosclerosis). Due to the blockage of the arteries delivering oxygen to the heart muscle, Mr. Cole has required two stents. Stents are small devices placed in the arteries to widen them and support them open so that blood is able to deliver oxygen to the heart muscle. He is more susceptible to heat because it impairs the ability of the heart to respond to heat stress, and the response to increase rate of beating and volume he cannot do.

110. According to his medical records, Mr. Cole's medications include metoprolol (Lopressor). Metoprolol is a beta blocker used to treat hypertension, angina, and cardiac dysfunction

111. Mr. Cole also takes hydrochlorothiazide (HydroDiuril). This is a diuretic used to treat hypertension. As explained above, diuretics reduce the amount of blood volume circulating in the body and impair the ability of the heart to increase cardiac output. When cardiac output is reduced during heat stress, there is a greater risk of heat stroke.

112. Mr. Cole takes a medication named metformin (Glucophage). Metformin is a treatment for the control of glucose levels in patients with diabetes. Metformin is eliminated from the body by the kidneys. If a patient gets dehydrated, he does not have as much water infusing the kidneys. A decrease in normal function of the kidneys can cause an accumulation of metformin and critical illness. This is important in the living circumstances of Mr. Cole; prolonged exposure to high temperatures may lead to dehydration, impaired kidney function, and decreased elimination of metformin, with dangerous accumulation of metformin in the body. If you accumulate metformin, you can develop lactic acidosis, and you can die as a result.

113. Mr. Cole takes losartan (Cozaar). This is an angiotensin blocking drug used to control blood pressure. The mechanism of effect is by blocking of the angiotensin type II receptors. The adverse effects may include impairment of the kidney function and hypotension. In the setting of dehydration, these effects may be magnified, as explained above.

114. Mr. Cole takes atorvastatin (Lipitor) for the treatment of high cholesterol and cardiovascular protection. Mr. Cole also takes isosorbide mononitrate (Imdur). This relaxes the smooth muscle of the arteries carrying blood to the muscle of the heart and is for the prevention and treatment of angina. Angina is chest pain that results due to inadequate oxygen delivery to the heart muscle. These conditions contribute to cardiovascular disease, a major risk factor for heatstroke and death.

115. Mr. Cole’s medication list includes enalapril (Vasotec). It would be unusual for a patient to be on this angiotension converting enzyme inhibitor (ACE inhibitor) and the losartan (angiotension receptor blocker) at the same time as both have similar effects and adverse effects. You typically do not see them taken together. Separately, they affect the sodium-water balance system, which is located in the kidneys. They are anti-hypertensives. The kidneys control the amount of sodium the body holds on to and the amount leaving the body. The kidneys also control the amount of water (“free water”) the body puts out. Whenever you alter the sodium-water system in the kidneys, there are consequences. If you are dehydrated and you are on these medications, you could develop kidney injury. An up to date medication list would clarify whether or not these medicines are being prescribed together.

116. Mr. Cole is prescribed nitroglycerin to treat chest pain due to angina. This indicates he has high risk cardiovascular disease.

117. Review of Mr. Cole's medical records show that Mr. Cole has submitted I-60 forms to inform the staff that the fans in the living fans were not operational and the heat was intense.

118. Mr. Cole's medical record indicates that on August 8, 2008 that he presented with nausea and vomiting. That day the temperature in Navasota was 96 (without humidity). These symptoms could be due to heat related illness. The medical record indicates he was taking meclizine as an anti-dizziness drug. That is a strong anticholinergic drug, which impairs sweating. Meclizine has anticholingergic properties, and it renders a patient susceptible to heat illness by blocking the ability to sweat. If you are dehydrated and cannot sweat at the same time, then your ability to thermoregulate is even more compromised, and you are greater risk of heat stroke. The record indicates that Mr. Cole was taking furosemide at the time. Furosemide is a diuretic (Lasix) that dehydrates you, and this would cause him to be susceptible to heat-related disorders.

119. There are several instances in the medical records where Mr. Cole presented with medical complaints that were consistent with heat-related complaints. For example, medical records from June 30 2012 (Bates 00002875) show that Mr. Cole was brought to the clinic for dizziness for 30 minutes, his condition was guarded, and they ordered oral fluids for him and returned him to his inmate housing area. Medical records from August 27, 2012, when the high temperature in Navasota was 93 (without humidity), indicate the Mr. Cole became overheated while in the pill line. (Bates 00002870). On May 17, 2014 he indicated in a sick call request that his problem that day was being “exposed to extreme heat conditions.” (Bates 00002821)

120. Based on a review of Mr. Cole’s medical records, which provide information about his age, his medical conditions, and the medications he takes, it is my opinion that he is at extremely high risk of heatstroke or other serious heat-related illness as a result of the prolonged exposure to extremely high heat indexes in the inmate housing at the Pack Unit. Given the severity and seriousness of his medical conditions and the effects of his medications on his ability to thermoregulate, Mr. Cole’s health is endangered when he is confined in such hot conditions.

C. Plaintiff Richard King

121. King has Insulin dependent diabetes and hypertension and the following medical conditions are noted in his chart:

Chronic Kidney Disease Clinic Note 6/7/2015 age 68
Diabetic neuropathy first observed 11/29/2005
Obesity first observed 1/2/2—7
Renal insufficiency first observed 3/5/2009
Dyspena first observed 3/5/2009
Diabetes type II insulin dependent first observed 1/4/2011
Hypertension diagnosed 1996
DM diagnosed 2009

122. His medications as extracted from his medical records have included at various times metformin, atenolol, analapril or lisinopril, hydralazine, postassium, hydrochlorothizide, terazosin, aspirin, apresoline and hydrodiuril.

123. His hypertension is not well controlled, as noted in his medical records on February 1, 2013, and on multiple other occasions (including 7/26/12, 7/27/10, 7/7/11, 3/12/15, and 3/30/15).

124. Mr. King has chronic kidney disease, as documented throughout his chart

125. Likewise, his diabetes is not well controlled, as evidenced from his chart on 2/9/15, 10/15/14, 6/2/14, 6/4/13, 3/9/13, and 12/6/12.

126. Based on a review of Mr. King's medical records, which provide information about his age, his medical conditions, and the medications he takes, it is my opinion that he is at extremely high risk of heatstroke or other heat-related illness as a result of the prolonged exposure to extremely high heat indexes in the inmate housing at the Pack Unit. Given the severity and seriousness of his medical conditions and the effects of his medications on his ability to thermoregulate, Mr. King's health is endangered when he is confined in such hot conditions.

D. Plaintiff Ray Wilson

127. Mr. Wilson has the following medical conditions: COPD, chronic bronchitis and emphysema, hypertension, coronary artery disease, right hip arthroplasty, and face, cirrrhosis basal cell carcinoma.

128. His medications included at various times the following: Plavix, Aspirin 325 mg, Atrovent, Enalapril. Hydrochlorothiazide, Isosorbide, Metoprolol, Nitrostat for chest pain, cyproheptadine, Chlorphenirimine, Qvar inhaler, Loperamide, Loratadine, Meloxicam, Naproxen, Bismuth, Pravastatin, Prednisone, and Proventil.

129. Based on my review of Mr. Wilson's medical records, which provide information about his age, his medical conditions, and the medications he takes, it is my opinion that he is at extremely high risk of heat stroke or other serious heat-related illness as a result of the prolonged exposure to extremely high heat indexes in the inmate housing at the Pack Unit. Given the severity and seriousness of his medical conditions and the effects of his medications on his ability to thermoregulate, Mr. Wilson's health is endangered when he is confined in such hot conditions.

E. Plaintiff Jackie Brannum

130. Based on my review of his medical records, Mr. Brannum suffers from the following medical conditions: coronary artery disease, hypertension, schizoaffective disorder, arthritis,

hyperlipidemia, and high cholesterol. He also has a history of tardive dyskinesis, as documented on March 6, 2013.

131. Mr. Brannum has been prescribed the following medications: Amlodipin, Enalapril, fluoxetine, gembriozil, hydrochlorothiazide, nitrostat, amitryiptyline, novolin, insulin, pravastatin, respiridone terazosin, gemfibrozil, metoprolol, meloxicam, carbamazepine, and Geodon.

132. Mr. Brannum submitted a sick call on 9/23/13 complaining of lightheadedness while in the chow hall. At that time, his blood glucose was found to be 146. That day, the high temperature in Navasota was 90 (without humidity).

134. This episode could have been the result of heat-related medical conditions.

134. Based on my review of Mr. Brannum's medical records, which provide information about his age, his medical conditions, and the medications he takes, it is my opinion that he is at extremely high risk of heat stroke or other serious heat-related illness as a result of the prolonged exposure to extremely high heat indexes in the inmate housing at the Pack Unit. Given the severity and seriousness of his medical and psychiatric conditions and the effects of his medications on his ability to thermoregulate, Mr. Brannum's health is endangered when he is confined in such hot conditions.

F. Plaintiff Fred Wallace

135. Based on my review of his medical records, Mr. Wallace has been diagnosed with sleep apnea, major depression, obesity, and prostatic hypertrophy.

136. Mr. Wallace has been prescribed terazosin, verapamil, albuterol, chlorpromazine, diphenylamine, fluoxetine, ipratropium, omeprazole, cyproheptadine, enalapril, hydrochlorothiazide, chlorphenirmaine, and phenylephrine. Several of these medications increase his risk of heat-related illness or injury.

137. On June 21, 2011, Mr. Wallace was seen in the infirmary, and observed to be "physically exhausted." Mr. Wallace was seeking relief from the requirement that he work inside the prison – to be "medically unassigned." It appears his request was granted, and he was placed on the "heat sensitive" list. That day, the high temperature in Navasota was 96, without including humidity.

138. If Mr. Wallace has been seen in the infirmary due to dizziness and dehydration during the summer, those conditions were likely caused by the extreme heat indoors at the Pack Unit.

139. Based on my review of Mr. Wallace's medical records, which provide information about his age, his medical conditions, and the medications he takes, it is my opinion that he is at extremely high risk of heat stroke or other serious heat-related illness as a result of the prolonged exposure to extremely high heat indexes in the inmate housing at the Pack Unit. Given the

severity and seriousness of his medical and psychiatric conditions and the effects of his medications on his ability to thermoregulate, Mr. Wilson's health is endangered when he is confined in such hot conditions.

140. Based on my review of Mr. Mojica's record, he appears to be in good health, and does not appear to have any of the medical conditions associated with increased risk of heat-related illness or injury. His medical records do reflect he has "direct sunlight and heat restriction due to MH meds," but he is not currently prescribed any mental health medications, and is not listed on the list of inmates who are "heat sensitive." His only "mental health" records indicate he attended an anger management course, which he had asked to be enrolled in. If he was prescribed these drugs in the past, he is not currently prescribed anything that would increase his susceptibility to heat-related illness or injury above the susceptibility any human being would suffer when exposed to the extreme heat at the Pack Unit.

VII. Conclusion: Extreme Heat Poses a Serious Health Risk for All Prisoners at the Pack Unit

141. During the summer, inmates at the Pack Unit are exposed for prolonged periods to extremely high heat indexes above 88 degrees Fahrenheit, sometimes for months on end. In their housing units, the inmates lack access to air-conditioning or any other method of significantly cooling the environment. Also, the inmates are not able to regularly access air-conditioning at the Pack Unit during the hot summer months, even for a few hours a day.

142. Prolonged exposure to the levels of heat as documented at the Pack Unit, without adequate respite in air-conditioned areas, poses a substantial risk of serious harm to all of the inmates at Pack. Even young, seemingly healthy prisoners are at risk of serious harm, including heat exhaustion and heat stroke.

143. Based on the complaint and Rule 30(b)(6) deposition testimony, there are approximately 188 inmates at the Pack Unit are over the age of 65, according to TDCJ. These inmates are at extremely high risk of serious heat-related illness as a result of the prolonged exposure to extremely high heat indexes in the inmate housing at the Pack Unit.

144. A substantial number of inmates at the Pack Unit suffer from conditions that make them heat-sensitive, including common conditions such as hypertension, diabetes, obesity, and cardiovascular disease. These inmates are at extremely high risk of serious heat-related illness as a result of the prolonged exposure to extremely high heat indexes in the inmate housing at the Pack Unit.

145. A substantial number of inmates at the Pack Unit take certain categories of medications that make them heat-sensitive, including anticholinergics, beta blockers, and

diuretics. These inmates are at extremely high risk of serious heat-related illness as a result of the prolonged exposure to extremely high heat indexes in the inmate housing at the Pack Unit.

146. Inmates at the Pack Unit suffering from mental illness may have reduced ability to identify and cope with heat stress. These inmates are at extremely high risk of serious heat-related illness as a result of the prolonged exposure to extremely high heat indexes in the inmate housing at the Pack Unit.

147. Even assuming that the inmates at Pack have a steady supply of water and ice, and can take showers twice a day, these measures do not adequately reduce the risk of serious harm from the prolonged exposure to extremely high heat indexes.

148. The prisoners at Pack do not have regular access to air conditioning to adequately protect themselves from prolonged exposure to extreme heat. They also do not have access to a cool environments or safe temperatures at times when they feel the need to cool off in order to avoid dizziness, headaches, or other symptoms.

149. Even assuming that the inmates at Pack could take unlimited showers, this would not adequately reduce the risk of serious harm from the prolonged exposure to extremely high heat indexes. Showers are insufficient in reducing the risks of persistent heat stress posed by the temperatures at the Pack Unit.

150. Fans are not protective at the high apparent temperatures as documented at the Pack Unit. Fans do not to be protect from the adverse effects of prolonged exposure to extreme heat.

151. An infirmary at the prison that is open to the inmates 24/7, as well as the ability to make a "sick call" to go to the infirmary, would not adequately mitigate the risks of persistent heat stress that result from the high heat indexes inside the inmate housing. This is because some inmates may not recognize the need to go to the infirmary quickly enough. Other inmates may decline to initiate a "sick call" because of symptoms such as dizziness or headaches, to which they may react simply by lying down or trying to sleep, knowing that there is no substantial relief from the heat available at the Pack Unit. Other inmates may not get to the infirmary in time because heat stroke can set on suddenly and without warning.

152. It is important to note that the Prison charges a $100.00 annual "co-payment" to be seen as an urgent case, if the visit is not deemed an emergency. (Bates 3470). On one occasion (Bates 3470), the medical record reveals that Mr. Yates had not come in for an evaluation due to the $100 fee. The patient had been coughing up green phlegm, had shortness of breath and

dizziness with physical exertion. The examination demonstrated diffuse wheezes throughout all lung fields and coughing of yellow green phlegm. I am extremely concerned about the $100 premium (Bates 3470) as an impediment to all prisoners, including Mr. Yates, seeking help when experiencing symptoms that may portend serious or life threatening illness, especially when they are exposed to extreme apparent temperatures. I am concerned that this provision may discourage prisoners from getting help. Likewise, I would expect that many inmates are not reporting heat-related symptoms to medical personnel due to this penalty, and a general knowledge that complaining about the heat will not make any difference.

153. In addition, I observed that the infirmary at the Pack Unit does not have any equipment for advanced cardiac life support. They do not have any cardiac monitoring equipment. I did not see any cooling devices such as big bags of ice. If the infirmary needs emergency paramedic support, they would have to call out to the local EMS, which could take several minutes to arrive at the facility.

154. In my professional opinion, based on the facts set forth above, persistent exposure to extreme heat for inmates at the Pack Unit results in a serious health risk to all inmates. This includes a serious risk of heat stroke and other heat-related disorders. The current measures used to mitigate these serious risks – drinking water, daily showers, and the availability of an infirmary – are inadequate to sufficiently reduce the serious risk of harm to the inmates. To significantly reduce this serious health risk, the inmates should be housed in heat indexes of 88 degrees Fahrenheit or less.

I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct.

Executed this 7th day of August 2015, in New York, New York.

S Vassallo HS

Susi U. Vassallo, M.D.

Exhibit 3

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF TEXAS
HOUSTON DIVISION

DAVID BAILEY, MARVIN RAY YATES, KEITH COLE, and NICHOLAS DIAZ, individually and on behalf of those similarly situated, Plaintiffs,	§ § § § §	CIVIL ACTION NO. 4:14-cv-1698
v.	§ § § § §	
BRAD LIVINGSTON, in his official capacity, ROBERTO HERRERA, in his official capacity, and TEXAS DEPARTMENT OF CRIMINAL JUSTICE, Defendants.	§ § § § § §	

Amended Report of Michael A. McGeehin, Ph.D., M.S.P.H.

Table of Contents

I. Introduction

A. Qualifications

1. My name is Michael A. McGeehin. I am a senior health epidemiologist. I hold a Ph.D. in Environmental Health Sciences and an M.S.P.H. in Epidemiology. A full copy of my C.V. is attached to this report as Exhibit A.

2. I am the former Director of the Division of Environmental Hazards and Health Effects at the Centers for Disease Control and Prevention (CDC). The CDC is the nation's health protection agency. To accomplish our mission, the CDC conducts critical scientific investigations and provides health information that protects our nation against expensive and dangerous health threats. The Division of Environmental Hazards and Health Effects promotes health and by preventing or controlling illnesses and deaths that result from interactions between people and their environment.

3. I was Director of the Division of Environmental Hazards and Health Effects for eleven years. I was an epidemiologist with the CDC for thirty-three years in total.

4. My experiences at the CDC focused on environmental health and included epidemiologic investigations of mortality and morbidity associated with extreme heat and cold events. I was the lead scientist for the CDC on health effects from extreme heat and heat waves for more than fifteen years.

5. One of my responsibilities as Director was to provide consultation and leadership on environmental health problems, such as extreme heat, to public health scientists in local and state health departments and other federal agencies. I represented the CDC on environmental health issues in public forums, scientific conferences, and congressional hearings.

6. The French Ministry of Health requested my assistance in responding to the European Heat Wave of 2003. I have consulted on human health impacts from heat with eleven foreign government ministries and he has testified before Congressional Committees on numerous public health issues, including extreme heat. I advised the governments of Canada, as well as the Pan-American Health Organization and the World Health Organization, about preventing illness and death from extreme heat.

7. The City of Houston also requested my assistance with responding to a heat wave in the early 2000s.

8. As a Division Director for the CDC, I served as Co-Chair of the Health Sector of the U.S. National Assessment of Climate Change. This program was the White House's First National Climate Change Assessment to assess the potential health impacts of climate change on the U.S. population, including illness and death associated with extreme heat.

9. I also served on the National Advisory Committee of the Natural Hazards Research Center. The Center directs, and disseminates the results of, research on adaptation to natural disasters to reduce the impact of these events. The Center studies extreme heat as a type of natural hazard.

10. Before becoming a Division Director, I served as the Chief of the Health Studies Branch of the CDC for four years. In that capacity, I oversaw epidemiologic investigations of environmental health issues including extreme heat. I designed, directed, and evaluated environmental epidemiologic studies of extreme heat. I also provided expert scientific consultation about extreme heat to other CDC components, state and local governments, and other federal agencies.

11. After retiring from the CDC, I was a senior epidemiologist for the Research Triangle Institute from 2011 through February 2013. At RTI, I continued my work investigating the links between global climate change and increased heat-related illness. I also assessed how the risk of heat-related illness varies among different populations. In other words, I determined which populations were at high risk for heat-related illness.

12. I have also served as an Adjunct Assistant Professor in the Emory University School of Public Health since 2001, where I have lectured on many topics, including global climate change and extreme heat events.

13. I have received numerous honors and awards for my scientific research. I was a finalist for the CDC's Charles C. Shepard Science Award in 2004, and I was awarded the National Center for Environmental Health Director's Award for Scientific Leadership in 2004.

14. I have published numerous epidemiologic studies of extreme heat in peer-reviewed journals over the last twenty years. These publications include studies of risk factors for illness and death during extreme heat events, as well as assessments of the sufficiency of municipal response plans for heat emergencies. I contributed to studies of the Chicago heat wave of 1995, the Cincinnati heat wave in 2005, and the French heat wave in 2003. A selection of my studies is listed in Exhibit B

B. Materials Consulted

15. To prepare this report, I have reviewed the following documents:

a. The Plaintiffs' Complaint

b. Outdoor temperature logs maintained by staff at the Wallace Pack Unit from June 2012 through September 2012, May 2013 through September 2013, and May 2014 through August 11, 2014

c. Indoor temperature logs maintained by staff at the Wallace Pack Unit from September 2012 through June 2014

d. National Weather Service Heat Safety Matrix

e. Sample inmate grievances regarding heat

f. The criteria for reporting a heat-related illness to the TDCJ Emergency Action Center (Bailey 031992)

16. It is my understanding that I have not yet reviewed all of the relevant evidence available to the Plaintiffs' attorneys in this case. I anticipate modifying this report after I have reviewed all relevant evidence. This report reflects my opinion on the basis of my scientific expertise and the evidence I have reviewed thus far, to a reasonable degree of scientific certainty.

II. Epidemiology in General

17. Epidemiology is the science that deals with the incidence, distribution, and control of illness and disease in a population. In other words, epidemiology provides the information that enables us to understand and to control disease.

18. Public health depends on epidemiologists to define disease, determine the true risk of disease, identify the population(s) at increased risk of disease, trace disease outbreaks, and provide essential information on disease trends in a population or area. For example, epidemiologic studies have identified the links between radiation exposure and numerous cancers. Epidemiologic studies also established the link between air pollution and respiratory disease.

19. In addition to tracking health crises and outbreaks, epidemiologists are also responsible for discerning and understanding long-term trends in infectious disease and chronic illness based on gathering and analyzing health surveillance data.

20. The underlying purpose of all epidemiologic studies is to assess the strength of the relationship between a health outcome (disease, illness, injury, or death) and one or more risk factors. These factors may be physical (obesity), societal (poverty), or environmental (heat or air pollution). These factors may be either exposure factors having a direct relationship with the outcome (increasing daytime and nighttime temperatures) or risk factors of the population (age, socioeconomic status, general health status). Most studies attempt to study multiple risk factors and determine their various associations with the health outcome, individually and in combination.

21. Epidemiologists also evaluate specific health outcomes in terms of "relative risk" for an entire population. Relative risk is the health risk that exposure poses to a population as a whole, relative to the health risk in a population without that same exposure.

22. By determining risk factors and relative risk for an entire population, epidemiologists are able to advise public health officials about public health risks and interventions that lower those risks. Epidemiologic studies are tools that enable public officials to make informed choices to protect the public. We put out warnings to policymakers from mayors and city council members to people who run nursing homes encouraging them to put our findings into action. This is a main purpose of the CDC and a central task to which I have dedicated the last 30 years.

III. Epidemiologic Investigations of Heat-Related Illness

23. Epidemiological methods have been utilized in all assessments of the impacts of extreme heat events on human health conducted in the last 40 years. In addition to determining the public health risk that these heat events pose to communities, epidemiologists have identified populations at increased risk of becoming ill or dying from heat, highlighted interventions aimed at reducing risk, and assisted in preparing communities to reduce vulnerabilities to the impacts of extreme heat.

A. Types of Heat-Related Illness

24. It is well-established that prolonged exposure to high apparent temperatures causes heat-related illnesses, including heat cramps, heat syncope, heat exhaustion, heat stroke, and death. Although the increasing severity of heat illness is often presented as

occurring in stages, it is important to consider that these illnesses are not distinct with strong lines of demarcation separating them. Rather, the signs and symptoms characteristic of each type of illness may also occur in different stages and an individual's physiologic response to heat exposure may differ from the common progression of symptoms.

25. **Heat Cramps**. This early stage of heat illness is characterized by painful muscle cramps primarily in the legs and abdomen and by excessive sweating. The cramping is usually caused by the loss of water and electrolytes and can be reversed with basic first aid and fluid intake.

26. **Heat Exhaustion.** This more serious phase of heat illness begins to impact the central nervous system and includes symptoms such as intense thirst, heavy perspiration, dizziness, blurred vision, headaches, confusion, anxiety, nausea, and vomiting. During heat exhaustion, the skin may feel cool and moist and the person may have a weak, rapid pulse. Heat exhaustion is a serious condition. A person suffering from heat exhaustion must be moved to a cool environment and hydrated immediately.

27. **Heat Syncope.** Heat syncope is a brief loss of consciousness or collapse that results from heat exposure. It results from the increased demand on the heart to pump blood to the skin for cooling. A person may suffer a sudden, brief loss of consciousness. Heat syncope is a serious condition that requires immediate cooling of the body; without cooling, heat syncope can lead to heat stroke.

28. **Heat Stroke.** Heat stroke is a life-threatening condition. The person requires immediate medical attention. Symptoms include a weak, rapid pulse; hot, dry skin; rapid breathing; core body temperature of 105 degrees F; and progressive central nervous system involvement including restlessness, delirium, convulsions, and coma. Without immediate and competent medical care and support, heat stroke may lead to death.

29. Heat stroke may leave those who survive with permanent injuries. Unfortunately, there are few studies on the longer-term effects of heat stroke. One study showed that a third of heat stroke victims from the Chicago heat wave had not recovered after one year of follow-up.

30. Epidemiologic and clinical studies show clearly that heat illness impacts multiple organ systems including the dermatologic, cardiac, respiratory, metabolic, excretory, neurologic, and, possibly, immune systems. Essentially, the extreme heat begins to make a person ill by breaking down the body's cooling system and then overwhelming other organ systems.

31. Prolonged exposure to extreme heat results not only in these traditionally defined heat illnesses, but also other medical events that are caused or exacerbated by the heat. Because heat taxes multiple organ systems, prolonged exposure to extreme heat exacerbates medical conditions such as heart disease, COPD, and kidney disease. It also increases the chance of suffering from a stroke.

B. Difficulty Measuring the Risk of Heat-Related Illness

i. Measuring Heat

32. Measuring the health impacts of extreme heat in the United States is not always simple or straightforward. One difficulty for all environmental epidemiologic studies is accurately measuring the exposure to the hazard—in this case, the heat.

33. Measuring heat as it impacts human health requires a measurement of ambient temperature as well as humidity. Ambient temperature is the heat of ambient air, and humidity is the amount of water in the air. Humidity is a critical factor in the impact of heat on human health because high humidity impacts the body's ability to cool itself by decreasing the rate of evaporative cooling on the skin.

34. The National Weather Service, a component agency of the National Oceanic and Aeronautic Administration, issues advisories and warnings for excessive heat. The NWS publishes a chart that shows increasing levels of risk as ambient temperature and humidity rise. The combination of ambient temperature and humidity is expressed using a function called the heat index. The NWS consulted with the CDC and other health experts to create this chart. The CDC relies on this chart to assess the health risk of extreme heat and advise other governmental agencies about their responses to extreme heat.

35. Because heat index is a function of temperature and humidity, the heat index can be measured both indoors and outdoors. The heat index can be measured any place there is air.

36. Based on my experience studying heat-related illness in various types of buildings, I know that in some buildings, the heat index is typically higher indoors than outdoors over the summer months. For example, my team and I referred to some buildings as "brick ovens" when studying the Chicago heat wave of 1995. These buildings retained heat, even as the outdoor heat index fell, because the buildings were constructed with brick and flat tar roofs. In my experience, various factors inside the

building may raise the heat index indoors, including sunlight exposure, the amount of people inside the building, and facilities that raise the humidity such as showers.

37. There are two particularly salient aspects of the way heat indices pose a health risk.

38. First, it is well-established that high heat indices result in increased death and illness. High heat indices pose a greater challenge for the body to cool itself, leading to increased stress on the body's thermoregulatory system and, ultimately, other major organ functions. For that reason, a person living through the summer in a hot climate, such as the Southern United States, is at higher risk of heat-related death and illness than a person living through a summer in a cooler climate.

39. Second, it is equally well-established that the risk of heat-related illness climbs even higher during an extreme heat event. Extreme heat events are known colloquially as "heat waves," and characterized by heat indices significantly higher than normal for the region. The NWS institutes its national Heat Advisory/Warning system for extreme heat events when the heat index is expected to reach 105 degrees daytime or 80 degrees nighttime for at least two consecutive days. Local NWS stations may use these national criteria or may determine their specific criteria to initiate Watches/Warnings based on forecasts that project temperatures two standard deviations above the normal heat indices for the area, or forecasts of daytime and nighttime temperatures in the upper 1% or 2% of temperatures for that region.

40. Extreme heat events result in higher rates of death and illness. The epidemiologic evidence shows clearly that a combination of meteorological factors play a role in increasing risk of death and illness during a heat event. Those meteorological factors include daytime heat indices, nighttime heat indices, length of the extreme heat event, and time of year. All have been linked to deaths and illness.[1]

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[1] *See, e.g.*, A. Fouillet *et al.*, *Excess Mortality Related to the August 2003 Heat Wave in France*, 80 INT'L ARCHIVES OCCUPATIONAL & ENVTL. HEALTH 16, 16–24 (2006); Jan C. Semenza *et al.*, *Heat-Related Deaths During the July 1995 Heat Wave in Chicago*, 335 NEW ENG. J. MED. 84, 84–90 (1996); T. Stephen Jones *et al.*, *Morbidity and Mortality Associated with the July 1980 Heat Wave in St. Louis and Kansas City, MO*, 247 J. AM. MED. ASS'N 3327, 3327–3331 (1982).

41. People who live in hot climates such as the Southern United States therefore face a danger significantly higher than people who live in other regions. First, high heat indices pose a danger even in the absence of an extreme heat event. Second, when there is an extreme heat event in the South, residents face an additional, more serious danger.

ii. Measuring Heat-Related Death and Illness

42. Estimating the death and illness impact of heat in the US is also difficult because of the way death and illnesses are reported. Heat-related illness and heat stroke are not notifiable conditions. In other words, hospitals and health care agencies do not report heat-related illnesses to public health agencies in the way that most infectious diseases and some chronic diseases (such as cancer) are reported.

43. Heat-related deaths are often misclassified when medical personnel are unable to detect core body temperature at time of death, or unrecognized when medical personnel fail to consider the possibility that a death was heat-related. Because heat-related illnesses can cause various symptoms and exacerbate a wide range of existing medical conditions, the etiology can be difficult to establish when the health care provider does not witness the onset. As a result, it widely accepted that heat-related deaths are vastly underreported.

44. For example, medical examiners typically attribute heat exposure as a primary or contributing cause of death only if they record a core body temperature of >105 degrees F. Since people dying in heat waves are rarely found in time to measure accurate core body temperatures, heat-related deaths are frequently under documented.

45. Heat-related illnesses are underreported for the same reason. Hospitalizations and emergency room visits are categorized by the primary diagnosis, without reference to underlying factors that contributed to that diagnosis. For example, a patient admitted to the emergency room due to chest pains and difficulty breathing would be categorized as "cardiac," even if the ER doctor determined that the patient's symptoms were likely caused or worsened by the heat. The role of heat in the exacerbation of the illness is seldom identified—almost never.

46. Given the vast under-reporting and under-documentation of heat-related illness and death, the risks from heat-related illness as reported by epidemiologic studies are either accurate or an understatement, but are extremely unlikely to be an overstatement of the risks.

C. Epidemiologic Studies of Heat-Related Illness

i. Epidemiologic Studies Show that Extreme Heat Poses a Serious Health Risk

47. Epidemiologic studies show that prolonged exposure to extreme heat poses a serious health risk for all people. All studies of the major heat waves in the last 35 years have established that people both with and without any risk factors die from exposure to extreme heat.

48. Prolonged exposure to extreme heat poses a health risk because, even for a person without any risk factors, prolonged exposure to heat levels at "extreme caution" or above carries a risk of overwhelming the body's thermoregulatory system. Moreover, the average person underestimates the serious health implications of exposure to extreme heat. Due to this lack of awareness, people fail to take adequate precautions to protect themselves from the heat and increase their chances of falling ill. Moreover, people who begin to fall ill cannot protect themselves from further deteriorating. Heat-related illness results in rapid loss of cognitive function.

49. To understand the many epidemiologic studies of extreme heat, it is important to understand the concept of risk. Epidemiologic studies use the general term "risk" to convey the strength of the association between an exposure and a health outcome.

50. The main exposure in heat studies is some measure of heat or an extreme heat event. Investigators have used many metrics to represent extreme heat events in studies, including daily high temperature, nighttime temperature, heat indices (heat plus humidity), the number of days of the event, and various combinations of these factors. The health outcome measured in these studies has also varied. Although most studies focus on death (mortality) as the measured outcome, many illnesses (morbidity) have also been investigated, including cardiac, renal, and respiratory-related diseases.

51. Separate from the association between the exposure (some measure of heat) and the health outcome (death or illness), studies examine other factors that are associated with the health outcome in the presence of the exposure. These are risk factors. Risk factors are variables associated with an increased risk of disease or death. Risk factors drive public health actions. The knowledge of risk factors for all chronic and infectious diseases leads to the development of interventions designed to reduce risk and save lives.

52. While we know there are many risk factors that can increase a person's chance of falling ill or dying from extreme heat, having a risk factor is not a prerequisite. All

epidemiologic studies of extreme heat have shown that people without known risk factors still become ill and die. In other words, extreme heat is a threat to the entire population, not just to those with characteristics that increase their risk.

53. Extreme heat events are the most prominent cause of weather-related deaths in the United States. Over a 5-year period from 1999 to 2003, a total of 3442 heat-related deaths were reported in the US, an annual average of 688.

54. The public health risk posed by extreme heat has been studied many times, among various populations and in different geographical areas.

55. The CDC conducted one of the first epidemiologic investigations of extreme heat after the St. Louis heat wave of 1980. The St. Louis study was the first to identify the elderly living in urban areas as a population at high risk of dying in heat.

56. Subsequent extreme heat investigations have universally supported the finding that the elderly are at high risk in extreme heat. For example, studies of the major heat waves over the last twenty years (in Chicago, Europe, and Cincinnati) all found that the elderly suffered from heat-related illness at higher rates than younger people. I am not aware of a single heat investigation that found otherwise.

57. When a severe, prolonged heat wave hit Chicago in 1995, the local media and the public became alarmed as the number of bodies overwhelmed the medical examiner's facility and had to be temporarily stored in 6 large refrigerated trailers prior to being processed. In total, 745 people died from heat in Chicago during the event.

58. This extraordinary amount of deaths resulted in large part from Chicago's lack of a comprehensive, coordinated emergency heat response plan. Chicago had no plan in place for identifying high-risk populations, coordinating neighborhood assistance for high-risk populations, or preparing for overflow in emergency services and hospital beds. Most importantly, Chicago did not offer any way for its residents to access air conditioning.

59. This was a natural disaster without the buildings falling down. The impact of extreme heat events such as this one are downplayed primarily because they do not affect infrastructure. But extreme heat events account for more deaths in the United States than any other natural disaster.

60. As the Chief of the Health Studies Branch at the CDC, I oversaw the investigation of the people who died in the Chicago heat wave. We identified numerous risk factors

for dying from extreme heat. In addition to those over 65 years of age, people with chronic illness and conditions, those taking certain medications, males, and the socially isolated were found to be at increased risk. The investigation also found that access to air conditioning had a protective effect and significantly reduced risk.

61. In July and August of 2003, the most severe heat wave in recorded history descended on Europe. In total, 12 countries were impacted by the heat event and overall deaths increased for those countries by over 80,000 during the entire calendar year.

62. Following the European heat wave, a wide range of epidemiologic studies was conducted, focusing on different subpopulations and different geographical areas. For the most part, the investigators found increased risk for many of the same groups that had been identified during earlier heat events, including people who are socially isolated, the elderly, the chronically ill, and people taking certain classes of medications,.

63. Much of the epidemiologic work was focused on France and, in particular, around Paris. Death rates in Paris during the 2003 heat wave exceeded the normal rate by 149%.[2] In the suburbs of Paris, the mortality rate exceeded the normal rate by 174%.[3]

64. Data on mortality during the 2003 heat wave indicate that people in all age groups were at increased risk of death. There was excess mortality in all segments of society and increasing risk of death for all age groups over 35 years of age.[4] Although deaths were recorded among all age groups, mortality rates increased as age increased, with over 90% of the deaths recorded in Paris in those over 65 years of age. Social isolation was associated with a 600% increase in risk of death.

65. Studies of the French heat wave showed that various preventative measures had varying degrees of effectiveness. While other measures modestly reduced the relative risk of death, access to air conditioning was shown to reduce the risk of dying from heat during by up to 70%. There are no comparable data for other interventions such as frequent showering.

66. Although many of the risk factors identified in studies of the French heat wave were similar to those of the US investigations, the lack of air conditioning in many areas of France make direct comparisons with US results difficult. The rate of death and illness

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[2] A. Fouillet *et al.*, *Excess Mortality Related to the August 2003 Heat Wave in France*, 80 INT'L ARCHIVES OCCUPATIONAL & ENVTL. HEALTH 16, 16–24 (2006)
[3] *Id.*
[4] *Id.*

in France was dramatically higher than it would have been in a similar area in the United States with wide-ranging access to air conditioning.

67. Studies of French nursing homes were particularly instructive about the importance of air conditioning. I was surprised to find that nursing home residents in France were at an increased risk of death. This had not been a finding of the United States heat wave studies because nursing homes in the United States are air conditioned almost universally. French nursing homes generally were not air conditioned when the 2003 heat wave hit.

68. In all three of these cities—St. Louis, Chicago, and Paris—the city lacked any effective plan for responding to extreme heat events before the heat event occurred. The result was an extraordinary amount of preventable deaths and illnesses. Each of these cities now has a comprehensive coordinated emergency response plan for extreme heat events. If a plan had been in place before these heat waves hit, many less people would have died.

69. The information above reflects just 3 important extreme heat events and a brief summary of the findings identifying at-risk groups. Every epidemiologic study of heat that I am aware of leaves no room for doubt: extreme heat poses a significant health risk to all people, and an even more significant risk to at-risk groups discussed in more detail below. This finding is uncontroverted.

70. The risk of heat-related illness is entirely dependent on exposure to extreme heat. It would be simple for an official with complete control over inmates to eliminate the risk of heat-related illness if he wished to do so. An air-conditioned environment eliminates exposure to extreme heat, and thereby eliminates the risk of heat-related illness and death.

ii. Epidemiologic Studies Show that Some Groups are at an Even More Serious Health Risk

71. Despite the wide breadth of literature in this field, certain high-risk factors have been consistently identified throughout the literature over the last 2 decades. Officials charged with protecting public health must consider these factors as part of any effort to reduce the risk of death or illness from extreme heat. The consistently identified risk factors include**:**

a. **Age**. Though there have been slight differences in defining "elderly" among the studies, studies have shown that people over the age of 60 have

twice the risk of dying and a 250% greater risk of being hospitalized for heat stroke compared to younger age groups during a heat wave. Epidemiologic results consistently show that people over the age of 65 years are at increased risk of dying or becoming ill from elevated temperatures. Elderly people are physiologically less effective at reducing body temperature, primarily through breathing and perspiration.

b. **Poverty**. Lower socioeconomic groups are also at increased risk. Based on my experience at the CDC, I have found that impoverished groups are at a higher risk of heat-related illness because they lack air conditioning in their homes and they do not have reliable, convenient transportation to public areas with air conditioning. Similarly, people in institutional settings may not have reliable access to air conditioning, suggesting that they are at the same heightened risk.

c. **Gende**r. Most U.S. studies have shown males to be at increased risk, possibly because men are more likely to participate in high-risk activities and ignore the dangers of heat. Men are also more likely to be isolated as they age.

d. **Social Isolation.** Studies in this country and in Europe have shown that people who live alone and do not interact with other people on a regular basis are at increased risk of adverse health outcomes, particularly death, when exposed to extreme heat.

e. **Chronic Illness.** Exposure to heat exacerbates existing health issues leading to greater hospital admissions, emergency department visits, and deaths. Chronic conditions that have been exacerbated by exposure to extreme heat include cardiac, respiratory, renal, and thyroid disease, hypertension, diabetes, and mental illness. The obese are also at increased risk from heat.

f. **Medications**. Broad classes of drugs have been indicated as increasing risk from elevated temperatures, usually by altering the body's physiologic response to heat. Anticholinergics, anticonvulsants, amphetamines, antihistamines, ephedrine/ pseudoephedrine, antipsychotics, diuretics, antidepressants, and beta blockers have all been identified in one or more epidemiologic investigations.

72. Institutionalized populations may also be a group at higher risk because they do not have access to air conditioning at their own discretion. I am not aware of any studies on this subject because institutionalized populations are not normally included in general population epidemiologic investigations.

73. The 2003 French heat wave studies do provide a useful point of comparison for risks faced by persons with little control over their environment.

74. Following the 2003 heat wave, investigators analyzed the death rates for nursing home patients in the area around Paris. Unlike the United States, most nursing homes in France are not air conditioned; therefore, these patients were exposed to the heat. Also, nursing homes are populated by many high-risk groups, including the elderly and chronically ill.

75. In a study of all nursing homes included in France's largest public hospital group, mortality rates increased from an average of 2.2 persons per month before and after the event to 9.2 persons per month during the heat wave, an increase of 410%.

76. This study shows the dramatic impact of heat on an institutionalized population in an environment without air conditioning.

D. Meaningful Intervention by Policymakers Can Lower the Risk of Heat-Related Illness

77. Epidemiologic research is conducted to understand illness and disease and to identify risk factors that increase a person's likelihood of developing these conditions. This information is then used to develop interventions or adaptations to reduce these risks.

78. For extreme heat events, certain adaptations have been identified to reduce mortality risk consistently throughout the published literature. These adaptations can be generally divided into societal and personal.

79. Societal adaptations to reduce heat-related illness and death focus primarily on community-wide extreme heat event response plans. The best of these plans are activated by an early warning system based on a National Weather System advisory and contain elements that provide for effective communication with high-risk groups; coordination among government and private agencies; multiple personal contacts with elderly and ill people living alone; increased availability of, and transportation to, air conditioned safe

areas; and increased awareness of heat-related signs and symptoms among emergency medical service units and other health care personnel.[5]

80. Every major city in the United States that has suffered the impacts of an extreme heat event has a societal adaption in the form of an emergency heat response plan. Every such plan includes a sufficient number air conditioned cooling centers, and measures to transport vulnerable community members to those cooling centers during an extreme heat event.

81. Increasing access to air conditioning is the central aspect of any heat response plan.

82. Government agencies in the Southern United States have almost universally adopted air conditioning as a basic necessity in their facilities. As a public health expert, I am not aware of any federal or state building without air conditioning except TDCJ prisons. In fact, in my experience, when the air conditioning goes out in a federal office building, workers are sent home for the day.

83. Personal adaptations include limiting or eliminating strenuous activity during the hottest time of the day, drinking non-alcoholic fluids, wearing light clothing, showering frequently, and cooling off in air-conditioned buildings.

84. These personal adaptations can marginally lower the risk illness from extreme heat, but there is no support in scientific literature for the overall effectiveness of these measures for populations in general. Air conditioning is the one exception. The only intervention that consistently reduces the risk of heat-related illness is air conditioning.

85. The use of fans is not an effective personal adaptation to extreme heat. Use of fans indoors, in rooms without air conditioning, should be discouraged during an extreme heat event.

86. Although fans provide a cooling effect by evaporating sweat from the skin at lower temperatures, fan use can pose a significant risk above a certain heat index (95 degrees F). When the heat index is that high, the fan may increase heat stress by blowing air that is warmer than the body temperature over the skin surface. The use of the fan also gives the person a false sense that they are reducing their personal heat risk in an effective manner.

[5] My coauthor and I identified and discussed these criteria for adequate heat event response plans in a 2004 publication. Susan M. Bernard & Michael A. McGeehin, *Municipal Heat Wave Response Plans*, 94 AM. J. PUB. HEALTH 1520 (2004).

IV. Heat Illness Risk in Wallace Pack Unit

87. I have great concern about the unrelenting nature of the heat exposure on the individuals housed in the Wallace Park Unit facility. Inmates at the Pack Unit are being exposed to high heat and humidity without respite. Even during a summer period with no period of extreme heat (heat wave), the combinations of temperature and humidity measured in the residential areas of the Unit represent a hazardous environment for healthy inmates and a dangerous situation for high-risk inmates.

A. Heat Levels in the Pack Unit Dormitories Pose a Danger to the Inmates

88. I have reviewed temperature and humidity data that represent prolonged, unrelenting exposures to conditions that pose increased risk to the inmates of the Wallace Park Unit. The indoor temperature and humidity data that I reviewed was from the summer of 2013 and 2014, so these conditions represented typical summer month exposure for the inmates, not a period of unusual, intense heat and humidity that would be associated with a heat wave.

89. Inmates at the Pack Unit exposed to high heat and humidity without respite. Except for a few early morning hours on some days when the temperature falls below 80 degrees, I could find no break from the high heat indices for these individuals for months on end.

90. For example, data for September 2, 2014 show a heat index of 92 degrees Fahrenheit immediately after midnight, rising to above 100 for much of the afternoon, and only decreasing to 91 at 11:50 pm. National Weather Service data indicate that September 2, 2014 was an average summer day in East Texas. There was no heat wave occurring in the area, yet the inmates were exposed in the dormitory area to heat indices in the "Extreme Caution" range of the NWS Heat Index Chart for the entire day and night.

91. Even more worrisome is that this day represents a typical summer day for the inmates. The duration of exposure to extreme heat is a significant factor impacting the risk of heat-related illness. In fact, there is a lag between the onset of an extreme heat event and the deaths from the event, because people who survive the onset of an extreme heat event can later succumb to cumulative exposure. Every major study of extreme heat events over the last thirty years to consider this factor has found that the duration of an extreme heat event has a significant impact on its health risk. The cumulative impact of

24-hour exposure to dangerous temperatures over an entire summer puts Pack Unit inmates at an even higher risk for heat-related illness.

92. Heat kills more than 600 people each year in the United States, and almost all of these deaths occur among people inside overheated buildings. The indoor temperature logs that I reviewed for the summer of 2013 did not provide sufficient information to fully assess the risk that extreme heat may have posed to the inmates for that period.

93. The only logged temperatures for many of the days were recorded during the morning hours, frequently around 10:00 AM. On summer days, and particularly during an extreme heat event, heat indices inside a building will typically be lowest during the morning hours and climb steadily to reach a peak in the late afternoons. Recording temperatures in the morning hours will not provide a true indication of the potential risk to the population from extreme heat. Temperatures should be taken in morning and in the afternoon, when the building will be at its warmest. Recording temperatures in the morning and afternoon will permit policymakers to assess the true risk from extreme heat. Morning temperatures standing alone are extremely misleading.

94. Temperatures recorded indoors during the mid-afternoon (2:00 PM) on days during June 2013 showed temperatures in the mid-90s and heat indices above 100, or in the “Extreme Caution” to “Danger” range of the NWS heat index matrix. For a number of days in August 2013, heat indices indoors were consistently within the NWS “Danger” category. It is almost certain that every day in July and August, heat indices will reach into the extreme caution and danger ranges. These heat indices will be even more pronounced during extreme heat events.

95. From a health standpoint, these indoor heat levels constitute a dangerous environment for all healthy people, not just high risk populations. These measurements are even more worrisome because they were taken during a typical summer day, not during a heat wave or an extreme heat emergency.

B. Inmates at the Pack Unit are at Even Higher Risk than the General Population

96. All studies of heat-related illness and death have shown that older people, people with certain chronic conditions, and patients taking certain classes of medications are at increased risk of becoming ill and dying when living in a high heat environment.

97. The inmate population of the Wallace Pack Unit in October 2014 skews older than the general, free-living population of Texas with slightly more than 50% being older

than 50 years and 23.1% aged 60 or more years. As they age, inmates in this facility are at increased risk from heat. Studies have shown that people over the age of 60 have twice the risk of dying and a 250% greater risk of being hospitalized for heat stroke compared to younger age groups during a heat wave.

98. It is also my understanding, based on the documents that I reviewed, that the inmate population of the Wallace Pack Unit has a high rate of chronic illnesses that make them susceptible to the heat. Study after study has shown that people with chronic illnesses I identify in Section III.C are at increased risk of falling ill and dying during an extreme heat event. This is simply a fact that has been demonstrated by every investigation of extreme heat events.

99. It is also my understanding that a high percentage of the inmate population at the Wallace Pack Unit takes medications that interfere with their ability to thermoregulate. Study after study has shown that people who take the medications I identify in Section III.C are at increased risk of falling ill and dying during an extreme heat event. This is simply a fact that has been demonstrated by every investigation of extreme heat events.

100. It is also my understanding that the many inmates at the Wallace Pack Unit do not have a choice about limiting strenuous activity, showering frequently, or preventatively accessing air-conditioned areas. This means that inmates at the Pack Unit do not have the freedom to make personal adaptations that reduce their risk of heat-related illness.

C. Purported Interventions at the Pack Unit Do Not Protect Inmates from the Serious Health Risks of Extreme Heat

101. It is well-known that one can reduce the risk of heat illness by avoiding prolonged exposure to elevated temperature and humidity. This is not debatable. I have not seen any evidence that the TDCJ has taken effective steps to reduce this type of heat exposure for the inmates incarcerated in this facility. In fact, over the summer, the heat indices in Texas are nearly always high enough to pose a significant health risk.

i. The Pack Unit's Heat-Related Policies Do Not Protect the Inmates and Contain Misinformation

102. It is my understanding that TDCJ and the Pack Unit have no policy limiting inmates' exposure to extreme heat in the dormitories.

103. It is also my understanding that the TDCJ and the Pack Unit have no policy for responding to an extreme heat event.

104. As I discussed above, people who live in the Southern United States are at high risk for developing heat-related illness for two reasons. First, the region's summertime heat indices reach the "extreme caution" range and above every day for months on end. Second, an extreme heat event may occur on top of those high heat indices.

105. This twofold risk requires a twofold response plan. Any government agency that incarcerates people in the Texas climate, where summertime heat indices nearly always pose a serious health risk, needs two different policies: one, a policy for protecting inmates from typical summertime high heat indices, and two, a policy for protecting inmates from extreme heat events.

106. TDCJ's policy for protecting inmates from high heat indices is grossly inadequate. TDCJ's policy for protecting inmates from extreme heat events is nonexistent.

107. The most basic policy to protect inmates from high heat indices would require, at a minimum, limiting their exposure to the heat. As a matter of public health, government officials cannot protect people from the health risk of heat exposure without limiting that exposure. Any minimally effective plan to lower the health risk requires air conditioning for prisoners.

108. Access to air conditioning cannot be limited to specific times of day. All inmates must have access to air conditioning on demand, both as a preventative measure and to treat themselves when they feel symptoms of heat-related illness emerging.

109. The most basic policy to protect inmates in extreme heat events would, at a minimum, mandate that the warden stop all outdoor work and recreation to bring the inmates into an air-conditioned environment. There can be no discretion to permit inmates to go outdoors. A basic policy for extreme heat events would also have a specific plan for protecting inmates during a power outage, which is a common occurrence during an extreme heat event. Giving inmates extra showers and cold water during an extreme heat event is not even close to sufficient.

110. Of course, to implement a plan for responding to an extreme heat event, administrators and the Pack Unit must be informed that an extreme heat event is imminent. This requires close coordination with the National Weather Service to ensure that administrators are notified of an imminent extreme heat event. That coordination and planning must occur long before an extreme heat event occurs—the National Weather Service must be part of any team establishing a plan for extreme heat events.

111. As I mentioned above, TDCJ's sole policy attempting to protect inmates from the heat is grossly insufficient. TDCJ has adopted a policy that applies in the workplace only, AD-10.64 (rev. 6) dated November 10, 2008. This policy attempts to address inmate safety related to extreme temperature exposure in the work environment.

112. This directive generally follows occupational guidelines for working in extreme temperatures and includes procedures for responding to symptoms of heat cramps, heat exhaustion, and heat stroke. However, the directive includes a Heat and Humidity matrix that appears similar to the Heat Index (HI) matrix used by the National Weather Service to convey relative health risks posed by increasing temperatures and humidity.

113. The matrix used by TDCJ incorrectly designates certain HIs as being associated with the possibility of occurrence of specific stages of heat illness. For example, in this matrix an HI of 104 is noted as indicating a "Heat Exhaustion Possible" environment while an HI of 105 is determined to be "Heatstroke Possible".

114. I do not know on what scientific information these designations were based. Heat stroke is indeed possible at lower HIs. The attempt to draw such fine distinctions among various HIs and corresponding the body's response along those distinctions indicates a lack of understanding of the health impacts of exposure to extreme heat.

115. The body's response to heat is primarily a function of the HI combined with the length of exposure, but many other factors bear on the risk of illness and death, including overall health status, age, and activity before and during exposure. Health and weather agencies have expended considerable effort to effectively convey increasing HIs as representing increasing risk of heat illness for populations and individuals, not specific levels of risk (such as "heat exhaustion possible") that apply to all persons.[6]

116. In addition, clinical evidence is clear that heat illnesses do not always occur in the same progressive stages. Patients exhibiting any stage of heat illness must be removed from a hot environment in order to prevent heat stroke. The severity of the symptoms will worsen unless the exposure is interrupted and first aid care administered. To associate a level of HIs with a specific "stage" of heat illness unsubstantiated—for example, at heat indices where the TDCJ matrix indicates "heat exhaustion possible," an inmate could easily progress to heat stroke and death.

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[6] *See generally* Peter J. Robinson, *On the Definition of a Heat Wave*, 40 J. APPLIED METEOROLOGY 762, 762–775 (2001) ("[G]iven the relative simplicity of HIs and the range of human variability, it is not possible to use the index or thresholds to 'predict' any human health events . . . .").

117. This TDCJ directive AD-10.64 instructs the Warden to make determinations about inmates' exposure to extreme heat conditions based on the misinformation contained in the heat and humidity matrix attached to the directive. From a public health standpoint, this is not a sound policy. To make an informed decision about exposure, a policymaker must understand the risk of illness and death associated with his decision.

118. If the TDCJ is interested in linking HIs with actions to reduce risk of heat illness in inmates or officers, I would direct them to OSHA's "Using the Heat Index: A Guide for Employers" or the NWS Heat Index Matrix. TDCJ can then use the increasing health risk levels displayed in each of these government agency guides to trigger certain ameliorative actions such as increased cool water intake, rest, work schedules, and access to cool environments for both inmates and officers.

119. There were days in the records I reviewed when prison officials may have lacked information necessary to apply AD-10.64. On some days, no temperatures were logged for the facility, and a note of "staff shortage" was written on the log for those days. In other words, there are no records that prison staff attempted to determine ambient temperatures during certain August days in Texas for an uncooled facility housing hundreds of men and operated by a Texas state agency. Even using the NWS heat index chart in place of the flawed TDCJ matrix, no government official could make an informed decision about the risk of exposure without. considering the ambient temperature.

120. Section D.27 of the Correctional Managed Health Care Policy Manual provides guidance to the medical staff on heat and heat illness. This manual conveys important information to the medical care providers; however, it uses the same misleading HI matrix discussed earlier in the review of TDCJ'S occupational directive, AD-10.64.

121. Also, the Correctional Managed Health Care Policy Manual does not include obesity among the risk factors for heat-related illness listed in Appendix B. Obesity is a well-known risk factor for heat illness and death. Two separate studies of military recruits found that high body mass index increased a person's risk of suffering from heat illness in hot conditions by approximately 400%.

122. The manual never mentions the use of air-conditioned environments FOR preventing or responding to heat related illness. As discussed above, air conditioning is an absolutely indispensible component of any policy attempting to lower the risk of hear-related illness.

ii. The Pack Unit's Fans and Ventilation Are Insufficient to Protect Inmates from Extreme Heat

123. The most effective method to reduce the risk of heat illness and death is air-conditioning. Based on the documents I reviewed, TDCJ relies almost exclusively on the use of fans to reduce the health risk from prolonged exposure to extreme heat, TDCJ relies on ventilation and exhaust fans for the facility, industrial fans circulating air in inmate dormitories, and individual fans for use by the inmates.

124. At heat indices over 90 degrees, fans are useless for cooling the human body. At a 95 degree heat index, fans are likely actually harmful. At 95 degrees HI, the hot, moist air does not have a meaningful evaporative capacity to dry sweat and cool human skin. Circulating that air over a person's skin transfers heat into their body rather than cooling it.

125. The use of fans is also harmful because it gives inmates, guards, and policymakers a false sense of security. When the danger is at its highest, the fans in Pack Unit dormitories are not lowering the health risk. The fans are putting inmates at even greater danger.

126. When the heat index outdoors is the same or near the heat index indoors, ventilation of outside air ineffective in reducing indoor heat indices and, therefore, in reducing risk of heat related illness. When the heat index outdoors is hotter than the heat index indoors, ventilation puts inmates at even higher risk.

127. The elevated indoor temperatures measured throughout the summer in the Wallace Park Unit evidence the lack of effectiveness of the building ventilation.

128. Also, the importance to the TDCJ of ventilation fans as a method of keeping the inmate population safe from the dangers of excessive heat seems to have been lost in practice. In reviewing the temperature logs for the summer of 2013, certain building fans were listed as inoperative for the entire summer season. For example, C-12 fan (center overhead), D-14 fan, A-3 fan, and D-16 fan were all reported as nonfunctioning for extended periods of time, even for days when the HI rose into the "Danger" zone. If TDCJ relies heavily on ineffective ventilation fans to reduce heat risk for their inmate and officer populations, it was disconcerting to read logs that listed so many ventilation fans out of service for extended periods of summer heat.

129. However, even if operating at full capacity, these ventilation fans would not be effective in reducing the risk of heat-related illness for the inmates during a typical

summer day. When the heat index of the air outdoors is the same as the heat index of the air indoors, ventilation makes no difference.

iii. Access to Cool Water, Showers, and Shorts is Insufficient to Protect Inmates from Extreme Heat

130. The only other intervention by TDCJ to reduce heat risk that I reviewed was increased access to water (both drinking water and showers). These interventions are important minimal protections but ultimately inadequate to protect a population from unrelenting, continuous heat in both the working and living environments.

131. While access to clear, cool drinking water is essential to life and critical to reducing risk in extreme heat, hydrating alone will not sufficiently reduce the risk.

132. To stay properly hydrated during prolonged exposure to the heat indices at the Pack Unit, inmates must drink much more water than a healthy person would ordinarily need to drink in a day.

133. Drinking cold water is also a main component of the Pack Unit's response to extreme heat.

134. Publicly available documents from the Texas Commission on Environmental Quality indicate that the level of arsenic in drinking water from wells at the Pack Unit, 24 parts per billion, is more than twice the upper limit imposed by the Environmental Protection Agency and the World Health Organization, which is 10 parts per billion.

135. These 10 parts per billion guidelines are based on risk calculations derived from extensive studies of the health effects of arsenic.

136. Most places in the United States that have high levels of arsenic in drinking water also have extremely high levels of other minerals in the water. This makes the water extremely unpleasant to drink. Normally, health officials do not need to worry about people drinking contaminated water, because the water tastes so unpleasant that residents opt to buy drinking water instead. This is not an option for inmates at the Pack Unit.

137. Regardless of how palatable the water is, drinking this water is simply unsafe. Arsenic exposure is directly linked to human cancer. Chronic exposure to arsenic in drinking water is strongly associated with increased risk of bladder cancer. Prolonged exposure to arsenic has been linked to skin and lung cancer. Arsenic also has limited

strength of association with cancers of the liver, kidney, and other systems, as well as peripheral vascular disease.

138. These risks are significantly higher for people like inmates at the Pack Unit who drink much more water per day, and thereby ingest much more arsenic per day.

139. Based on the documents I have reviewed, the intervention on which TDCJ authorities at the Pack Unit most heavily rely for reducing risk of heat related illness is to drink large amounts of water. Drinking large amounts of water is not enough to prevent heat-related illness, and to the extent that it lowers risk at all, officials seem to be trading the risk of heat-related illness for a higher risk of cancer.

140. More frequent access to cool showers will cool the body, lower body temperature, and marginally reduce the risk of heat-related illness. However, cold showers twice a day are not sufficient to abate the serious risk of heat-related illness at the Pack Unit.

141. After reviewing the documents I reviewed for this report, including Warden Herrera's deposition, I was unclear about the conditions under which additional showers might be made available to the inmates, how many additional showers were available and at what times, or how inmates might avail themselves of the opportunity to cool down with additional showers.

142. Nothing that I have reviewed implies that TDCJ would recognize the threat of heat to the health of the inmates to the degree that they would disrupt normal operations to permit additional showers for the unit.

143. Wearing shorts permits a greater area of skin to interact with the air and, possibly, cool the body. Shorts can increase comfort and reduce body temperature, but like fans, the cooling effect is essentially eliminated at higher HIs. And, as is the case with extra showers, wearing shorts is not sufficient to abate the serious risk of heat-related illness at the Pack Unit.

iv. Pack Unit Staff Are Not Adequately Trained to Protect Inmates

144. A well-trained staff is essential to a rapid, effective response to a heat emergency, whether for an individual or for an entire facility. Recognition of a high-risk heat environment and the initiation of effective interventions or first aid actions for an inmate or officer in danger may be quite literally life saving for that individual.

145. I reviewed no evidence that the TDCJ has a comprehensive training program aimed at reducing risk of heat danger for inmates housed at the Wallace Pack Unit.

146. Based on the documents I reviewed, some high-level Pack Unit TDCJ staff at the Pack Unit are trained by the medical staff on-site. These TDCJ staff members then train the remaining lower-level TDCJ staff.

147. Heat-related training for staff responsible for the well-being of inmates housed in the Wallace Pack Unit seems to consist of one half hour training session in early June (as one half of their monthly training) for which the written material was a one page outline of the symptoms of the stages of heat-related illness. I could not ascertain if the training for the correctional officers involved anything more than reviewing the typical symptoms of heat illness as outlined in the written material.

148. It is unclear whether or how the highest-ranked staff at Pack, such as the Warden, are trained by medical staff about the risks of prolonged exposure to extreme heat.

149. The Unit also requires the officers to carry a card with information on the stages of heat illness. Identifying a person who may be suffering from heat-related illness is not a simple task. For example, it is difficult for an untrained person to distinguish a person who is sweating normally, from someone who is sweating excessively, from someone who has stopped sweating at all. It is unclear how effective the heat illness card is in light of the minimal training for correction officers.

v. Future Trends Will Soon Put Pack Unit Inmates at Even Greater Risk

150. In the coming years and decades, 2 important trends will greatly increase the probability of heat illness and death among the inmate population of the Wallace Pack Unit and the entire TDCJ system.

151. The first of these trends is the aging of the prison population in Texas. The number of inmates in the Texas prison system over the age of 55 years increased by 32% between 2007 and 2011. This trend is expected to continue into the next decade. Since older age groups are at much higher risk of suffering and dying from extreme heat, the aging of the population must be factored into any long term plan to address the issue.

152. The second critical trend is the changing of the world's climate. We are already experiencing the projection of the Intergovernmental Panel on Climate Change (IPCC) for more hot days and nights for the continental US.

153. The IPCC is United Nations authorized organization of over 7000 scientists from 195 countries that studies the nature and impacts of the world's climate.

154. The IPCC projects an increase in the frequency, duration, and intensity of extreme heat events for the US over the next 20 to 40 years. The most recent calendar year, 2014, was the hottest on record and 2012 was the second hottest.

155. In addition, the last complete decade, 2000-2009, was the warmest decade ever recorded. These are measurements, not opinion.

156. The IPCC projects that by mid-century the state of Texas will experience 4 times the current number of days reaching 100–105 degrees F.

157. An aging population and a warming climate represent significant obstacles in attempting to deal with heat in the Wallace Pack Unit with ineffective interventions. An already unmanaged hazard, heat, will increase appreciably while the most vulnerable population (the elderly) will also be increasing. This is a recipe for a public health disaster.

IV. Conclusion

In reviewing materials on heat and heat response for the Wallace Pack Unit of the TDCJ, I have found:

- Every death and illness from extreme heat is preventable. Air conditioning the dormitories would almost completely eliminate the risk of illness and death for inmates at the Pack Unit.

- Unrelenting exposure in the living areas to HIs that frequently rose into the "Danger" range and seldom fell below "Extreme Caution" even during night time and early morning hours

- Lack of a facility-wide, comprehensive policy or directive that communicates to staff the human health risks of extreme heat exposure; the preventive measures available to reduce these risks; the first aid and medical care for an individual suffering from one of the stages of heat illness; annual training requirements for staff and education for inmates; and other necessary elements for an effective facility heat plan. AD 10.64 is an occupation only focused directive.

- Ineffective interventions for reducing inmate risk of heat related illness and death. The limitations of fans, water, showers, and wearing shorts have been identified and even these interventions seem to be instituted unevenly.

- Fragmented, limited training on heat dangers and heat illness for the officers who are the first line of Unit staff to identify and respond to stages of heat illness.

- Future trends of an aging inmate population and a warming climate that will combine to increase both the heat risk and the most vulnerable population in that risk.

Most alarming, in assessing the risk to the men housed in this Pack Unit, is the obvious absence of urgency among the TDCJ officials in recognizing and effectively reducing the heat hazard as a substantial risk to the inmate population of this facility. It seems that the TDCJ does not recognize the risk of heat in their facilities and has failed to effectively reduce the risk or ensure the safety of the inmates in their charge. TDCJ officials have not even formulated or promulgated a comprehensive policy or directive to guide facility managers and other staff in dealing with heat and protecting the inmates.

I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct.

Executed this 13th day of January 2016, in Atlanta, Georgia.

Michael A. McGeehin

Michael A. McGeehin, Ph.D., M.S.P.H.

Exhibit 4

October 22, 2015

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF TEXAS
HOUSTON DIVISION

KEITH COLE, JACKIE BRANNUM, RICHARD KING, DEAN ANTHONY MOJICA, RAY WILSON, FRED WALLACE, and MARVIN RAY YATES, individually and on behalf of those similarly situated,	§	CIVIL ACTION NO. 4:14-cv-1698
Plaintiffs,	§	
v.	§	
BRAD LIVINGSTON, in his official capacity, ROBERTO HERRERA, in his official capacity, and TEXAS DEPARTMENT OF CRIMINAL JUSTICE,	§	
Defendants.	§	

Amended Expert Report of Dr. Linda O. Mearns, Senior Scientist, National Center for Atmospheric Research

Historical and Anticipated Future Temperature, Relative Humidity, and Heat Index Conditions for the Region Surrounding Navasota, Texas

1.0 *Expert qualifications*

I am a Senior Scientist at the National Center for Atmospheric Research, in Boulder, Colorado. I have a PhD in Geography with an emphasis in climate science received in 1988 from the University of California, Los Angeles. I have 27 years of experience in performing research on regional climate change including changes in variability and extreme events, the impacts of climate change, and uncertainties regarding regional climate change. I am an author on numerous international and national reports regarding climate change and its impacts, such as those of the Intergovernmental Panel on Climate Change and the U.S. National Climate Assessments. I have published about 130 research articles and other publications. My curriculum vitae is appended.

2.0 Overview of scope and tasks

2.1 I have been retained by Edwards Law and the Singley Law Firm to provide expert testimony regarding [historical] and future climate and assistance in connection with the case Bailey, et al. v. Livingston et al., cause no. 4:4 – cv – 1698, in the United States District Court , Southern District of Texas (Houston Division) ('Bailey'). I was asked to provide a statistical analysis of historical trends in various measures of temperature, relative humidity, and heat index (HI) as well as estimates of how these variables and indices might evolve in the future for the region surrounding Navasota, Texas.

2.2 My fees are not dependent on my findings, opinions, or outcome of the related arbitration. My findings are my own. In arriving at my findings I rely on the accuracy and completeness of daily climate data accessed through the NOAA GHCN (Global Historical Climate Network)[1] system for six stations in the vicinity of Navasota, Texas for 1970 through 2012, and hourly data of temperature and relative humidity at College Station from the NCDC Global Summary of the Day (GSOD) database[2] for 1973-2013. In addition, I rely on future climate information from a series of well-documented global and regional climate model simulations. All of my opinions are expressed to a reasonable degree of scientific certainty.

2.3 I reserve the right to supplement and/or revise my report at a later time if new, additional, or corrected information is obtained, or if I am asked to address additional issues or to re-analyze any issues discussed herein.

3.0 *General overview of the anticipated temperature increases and increases in the frequency of relevant temperature extremes as climate changes*

It is now very well documented that temperatures globally (including in the United States) are increasing and are anticipated to continue to increase as climate change resulting primarily from increased greenhouse gases in the atmosphere continues. These increases in temperature are indeed the hallmark of anthropogenically-induced climate change. According to the most recent report of the Intergovernmental Panel on Climate Change (IPCC, 2013a) 'it is extremely likely that human influence caused more than half the observed increases in global average surface temperature from 1951-2010'. Also, anthropogenic forcing (i.e., increased greenhouse gases and aerosols in the atmosphere) have made a substantial contribution to surface temperature increase on a continental scale, including that of North America and most sub-regions. The region of Texas containing Navasota

[1] http://doi.org/10.7289/V5D21VHZ

[2] http://www7.ncdc.noaa.gov/CDO/cdoselect.cmd?datasetabbv=GSOD

has exhibited steadily increasing temperatures for the past 20 years (Mellilo et al., 2014, Fig. 2.7).

With these observed increases in mean temperature come concomitant increases in extreme temperatures (Figure 1). It is likely that anthropogenic influences have led to increases in the extremes of daily minimum and maximum temperatures (on global and continental scales) since at least the middle of the last century (i.e., 1950).

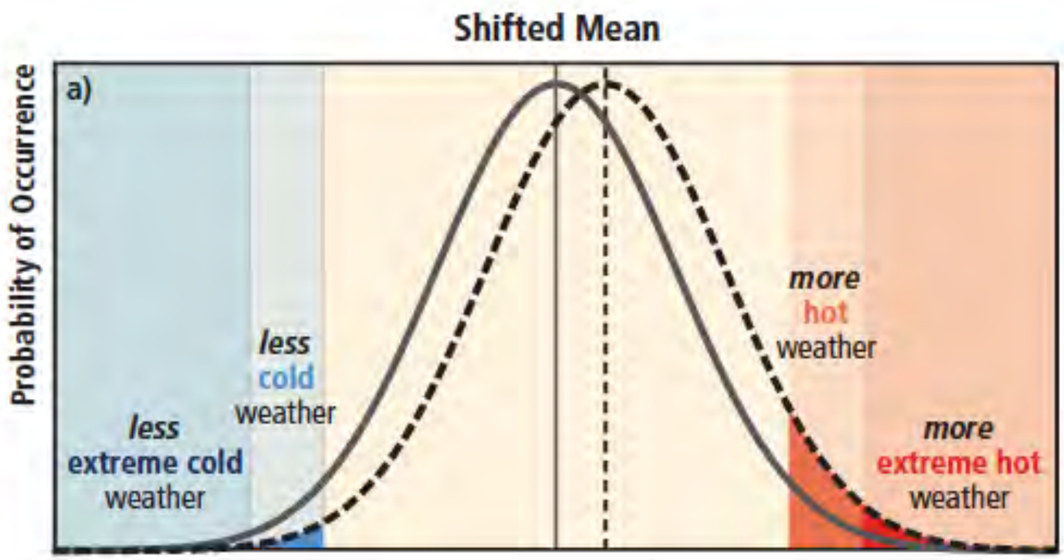


Figure 1. Illustration of how extremes change as the mean of temperature increases. Note that the change in the hot weather (extremes) is greater than the change in the mean temperature. (Adapted from IPCC, 2012, and see Mearns et al., 1984).

These increases in temperature are virtually guaranteed to continue as greenhouse gases continue to increase in the atmosphere. With the increases in temperature it is virtually certain that in most places there will be more hot and fewer cold temperature extremes on daily to seasonal timescales. Moreover it is very likely that heat waves will occur with a higher frequency and duration (IPCC, 2013a; 2012; Risky Business Project, 2015).

4.0 *Analysis of maximum and minimum historical temperature trends*

I present trend analyses of summer (June, July, August) maximum and minimum temperatures for six observational weather stations surrounding Navasota, Texas from the GHCN NOAA data set (Figure 2). We analyze the series of summer temperatures from 1970 through 2012. We also analyze the trends in exceedance of

certain key thresholds of daily maximum temperature, including 88, 95, and 100 °F at these stations. Trend analysis in this instance consists of relating a time series of temperature (one value per year) to time (years). Linear regression is used to establish how the temperatures change (i.e., the tendency) over time (over the series of years) by fitting a linear trend (regressing temperature onto years). This is a standard technique for scientifically analyzing trends in climate data. Stations include Brenham, College Station, Conroe, Madisonville, Sommerville Dam, and Washington State Park (for locations see Figure 2). Linear trends were fit through the data (1970-2012), and trends in °F per decade determined (see Table 1a,b).

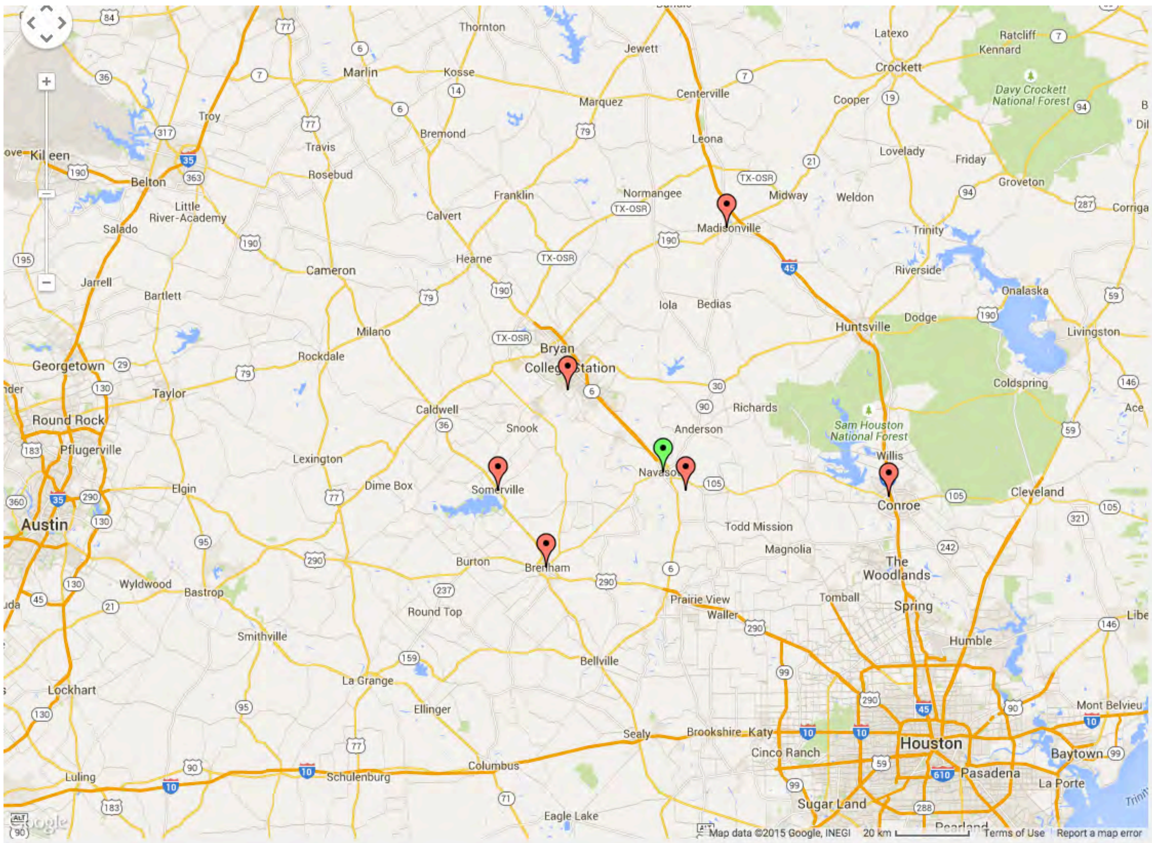


Figure 2. Locations of the six stations (red symbols) used in the study. Navasota's location is indicated by the green symbol. The station nearest to Navasota is Washington State Park.

4.1 <u>Trends of maximum and minimum summer temperatures.</u>

Trends for maximum mean summer temperatures across the six stations ranged from +0.5 to +1.9 °F per decade (Table 1a). Note that all trends are positive indicating that summer maximum temperatures are increasing at all locations. The significance of the trends is established, meaning that the probability that the trend

is different from 0.0 is established. Typically this is done by setting up a null hypothesis (i.e., that the trends are equal to zero, no trend) and rejecting it at some significance level (the 'p' value). The smaller the p value the greater is the certainty that the trend is different from zero. Typical p values considered as indicating significance are .1, .05, and .01. For these data, the trends are significant at the .05 level at three of the stations, and at the .1 level at one of the stations. Trends were not significant at Brenham and Conroe. Mean minimum summer temperature trends ranged from 0.0 to 1.1 °F per decade. All trends are positive and significant at the .05 level, except at Sommerville Dam (Table 1b). Hence, minimum temperatures are also generally increasing over this time period in this region.

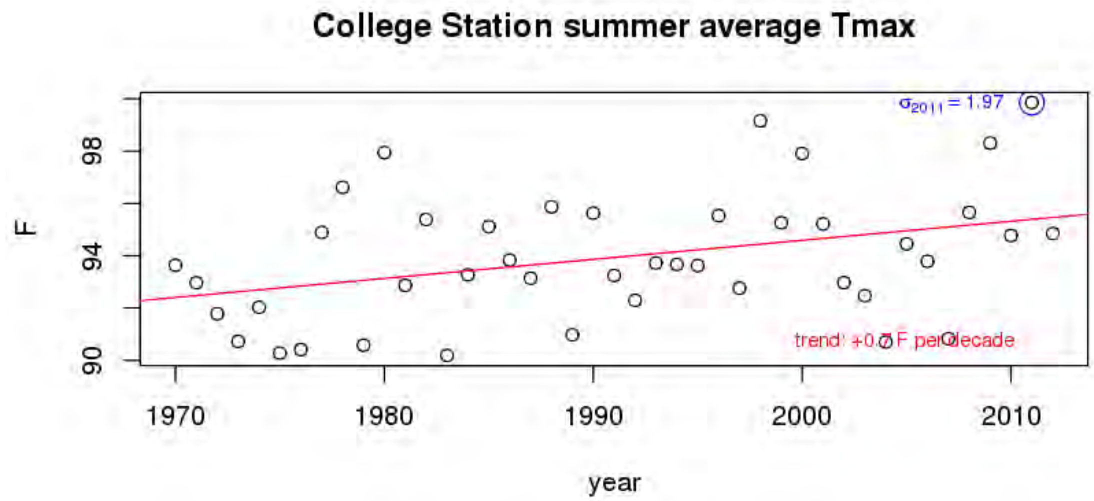
Table 1a. Trends in summer average maximum temperature 1970-2012

Station	Trend °F/decade	CI lower	CI upper	P value	Sigma 2011
Brenham	0.40	- 0.19	0.99	.18	2.3
Coll. Stn.	0.73	0.16	1.30	.01	2.0
Conroe	0.34	- 0.19	0.87	.20	2.5
Madison	0.47	- 0.09	1.02	.10	2.9
Som Dam	1.85	1.23	2.47	.00	1.5
Wash Park	0.98	0.34	1.61	.00	2.3

Table 1b. Trends in summer average minimum temperature 1970-2012

Station	Trend ° F/decade	CI lower	CI upper	P value	Sigma 2011
Brenham	1.06	0.81	1.31	.00	2.1
Coll. Stn.	0.47	0.21	0.73	.00	1.7
Conroe	0.72	0.45	1.00	.00	1.4
Madison	0.83	0.52	1.13	.00	1.4
Som Dam	0.02	-0.29	0.33	.88	0.0
Wash Park	0.33	0.04	0.62	.03	1.2

CI lower = lower bound for the .05 confidence interval; CI upper = upper bound for the .05 confidence interval; if the interval includes 0.00, then the trend is not significant at that confidence interval; P value = the significance level for rejection of the null hypothesis that the trend is equals 0.0 (see text for more detailed discussion); sigma 2011 = the degree of exceedance of the mean daily summer minimum temperature in 2011, compared to the standard deviation of the long term detrended time series.



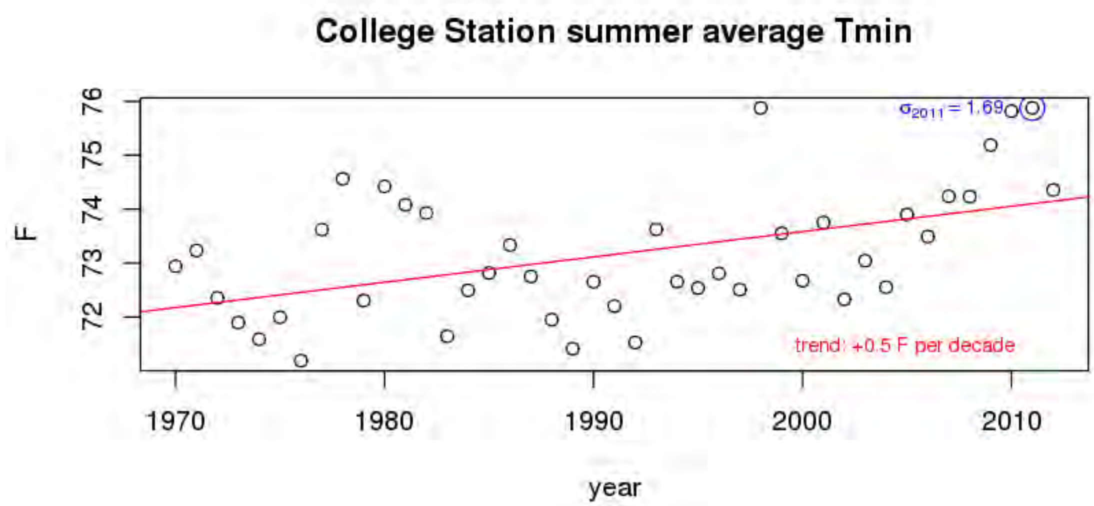


Figure 3. Time series of mean maximum (top) and minimum (bottom) summer temperatures at College Station, Texas. Y-axis is in units of °F. Red lines represent the linear trends in the data. Values for 2011 are circled in blue. 'Sigma 2011' is explained in Table 1.

4.2 Frequencies of extreme maximum temperatures

Along with positive trends in mean maximum summer temperature, we see positive trends in maximum daily temperature extremes. I considered three different thresholds of extremes: 88, 95, and 100 °F at the six stations. At all stations we see positive trends in extremes at the three thresholds (Table 2). Out of the 18 statistical tests performed on these trends, 10 showed statistical significance at the .05 level (Table 2). For daily maximum temperatures at or above 100 °F, we see trends ranging from 2.1 days per decade at Brenham (not significant) to 10.8 days per decade at Washington State Park (significant at the .05 level). At the 100 °F

threshold, trends are significant (at the .05 level) at four of the six stations. Results for College Station are shown in Figure 4.

Table 2. Trends in frequency (number of days per year) of extreme daily maximum temperatures 1970-2012

Station	Threshold °F	Trend (days/decade)	CI lower	CI upper	P value	Sigma 2011
Brenham	88	2.47	-1.23	6.2	.18	2.37
Brenham	95	3.41	-3.05	9.9	.29	2.00
Brenham	100	2.05	-2.23	6.3	.34	2.54
Coll. Stn	88	6.27	2.91	9.6	.00	1.90
Coll. Stn	95	7.39	1.47	13.3	.00	2.22
Coll. Stn.	100	3.59	-0.03	7.2	.05	2.83
Conroe	88	0.67	-3.46	4.8	.07	2.31
Conroe	95	4.17	-1.58	9.9	.15	2.41
Conroe	100	2.52	0.32	4.7	.03	4.12
Madison	88	2.79	- 1.67	7.3	.21	2.06
Madison	95	4.68	- 1.17	10.5	.11	2.66
Madison	100	4.00	0.51	7.5	.03	4.38
Som Dam	88	8.81	4.91	12.7	.00	- 0.69
Som Dam	95	16.40	10.68	22.1	.00	0.01
Som Dam	100	10.77	6.60	14.9	.00	0.69
Wash Park	88	9.49	5.03	14.0	.00	1.94
Wash Park	95	10.19	4.05	16.3	.00	2.10
Wash Park	100	6.73	2.66	10.8	.00	3.05

CI lower = lower bound of the .05 confidence interval; CI upper = upper bound of the .05 confidence interval; if the interval covers 0.00, then the trend is not significant at that confidence interval; P value = the significance level for rejection of the null hypothesis that the trend is equal to 0.00; Sigma 2011 = the degree of exceedance of the mean daily summer maximum temperature in 2011, compared to the standard deviation of the long term detrended time series. A negative value for sigma 2011 means that the value for that year at that location was below the trend line, and thus took on a negative value when the data were detrended.

4.2.1 Extremity of the summer 2011

We also analyzed how extreme the temperatures in the summer of 2011 were ('Sigma 2011' in Tables 1 and 2). The summer of 2011 was an extreme one for Texas. However, it should not be considered a unique event that will never occur again. It should be noted that other years also experienced similarly extreme temperatures, for example, 1998. And it is expected, given the trends in the data

and expectations based on climate change (see section 5), that extremes of this magnitude will become more common in the future. This year was also extreme in terms of the frequency of daily extremes (e.g., days over 100 °F) (Figure 4 and Table 2). According to Meehl et al. (2009) the US as a whole has seen many more record breaking high temperatures than record breaking lows in recent years. They also determined that by the middle of this century the ratio of record breaking high to record breaking low temperatures would increase to 20 to 1.

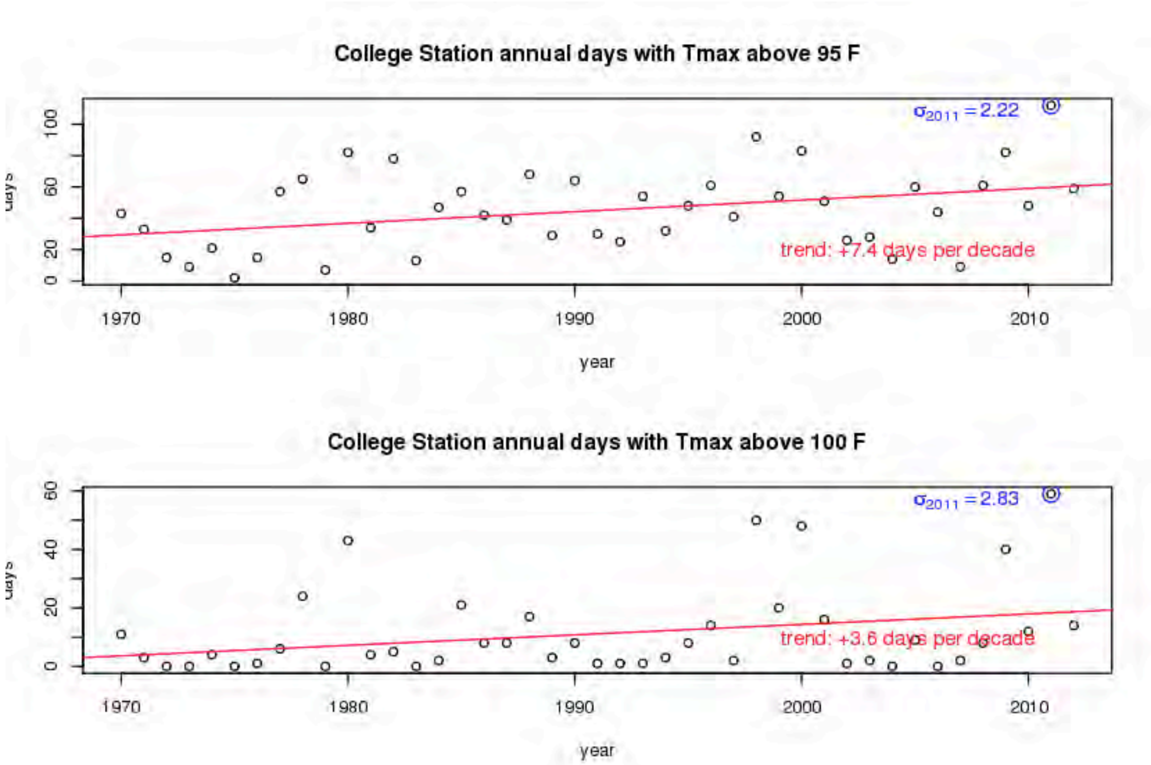


Figure 4. Trend in days greater than or equal to 95 (top panel) and 100 °F (bottom panel) at College Station throughout the year. The values for the year 2011 are circled in blue. See Table 2 for more details on sigma 2011 and trend.

4.3 Trend in summer relative humidity

From an additional data set that included hourly relative humidity, the National Climate Data Center (NCDC) Global Summary of the Day (GSOD) I analyzed the trend in summer mean relative humidity at College Station (Figure 5). College Station is 22.4 miles from Navasota. While there is a weather station closer to Navasota (Washington State Park) only the GHCN data (daily temperatures) are available and not hourly relative humidity and temperature. The GSOD data set had complete data for 1973-2013 at College Station. We see a distinct decreasing trend over the

41-year period of -2 percentage points per decade for summer relative humidity. The trend is significant at the .05 level. Note that in 2011, the value is relatively low, about 58%. It is often the case for this region that very high temperatures will be paired with relatively low humidity.

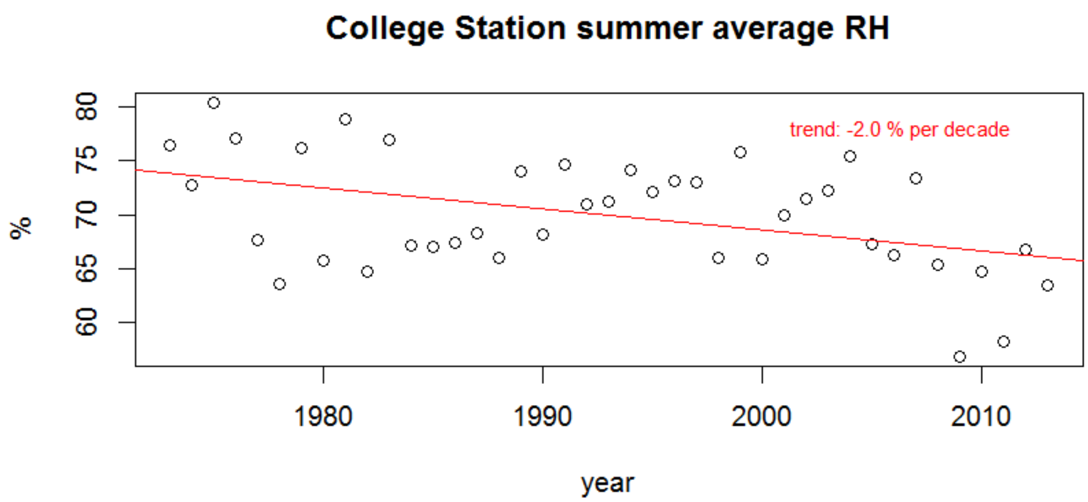


Figure 5. Time series of mean summer relative humidity (1973-2013) at College Station, with the linear trend (red line). The trend is significant at the .05 level.

4.4 Trend in the Heat Index

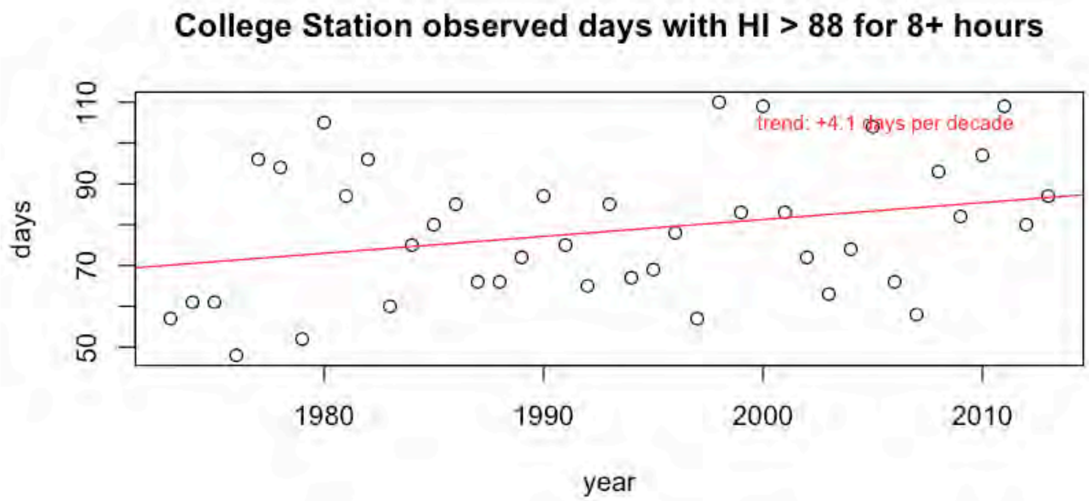
The following formulation for the National Weather Service Heat Index (HI) (http://www.wpc.ncep.noaa.gov/html/heatindex_equation.shtml) based on the work of Steadman (1979) and Rothfusz (1990) is applied at College Station on an hourly basis, 1973-2013. The data come from the NCDC Global Summary of the Day (GSOD) database (http://www7.ncdc.noaa.gov/CDO/cdoselect.cmd?datasetabbv=GSOD).

$$HI = -42.379 + 2.04901523*T + 10.14333127*RH - .22475541*T*RH - .00683783*T*T - .05481717*RH*RH + .00122874*T*T*RH + .00085282*T*RH*RH - .00000199*T*T*RH*RH,$$

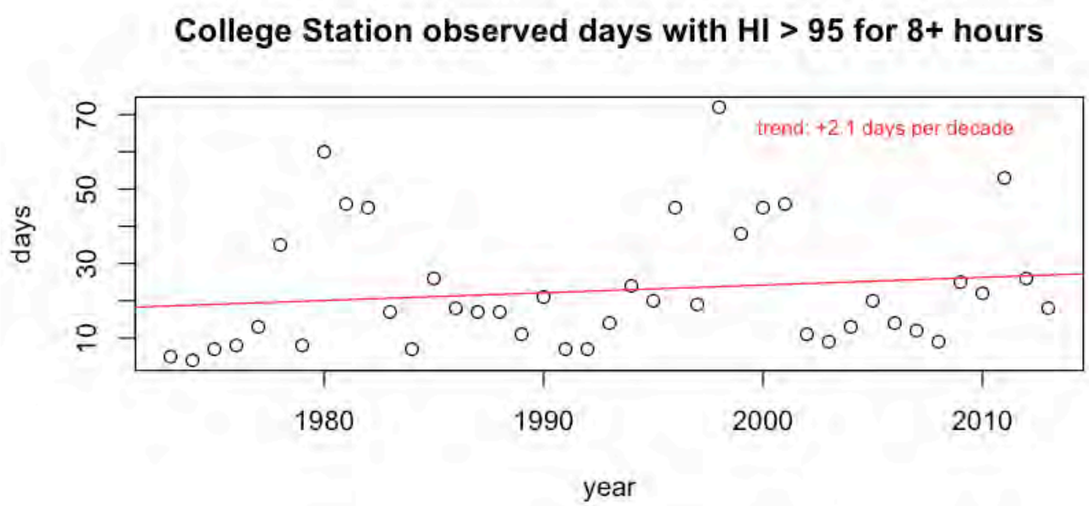
where T is temperature in °F and RH is relative humidity in percent. HI is the heat index expressed as an apparent temperature in °F. This equation is adjusted for certain particular conditions, such as when RH < 13% and temperature is between 80 and 112 °F; or when RH > 85% and temperature is between 80 and 87 °F. Also, a simpler formulation is used if HI < 80. Finally, the equation is not valid for very extreme conditions that are outside the range of data used by Steadman (1979) for developing the empirical relationships.

Using hourly relative humidity and temperature data for College Station for 1973 through 2013, I produced the trend in the heat index exceeding key thresholds (e.g.,

88, 95, 100 °F) for particular durations (4 and 8 hours) per day at the request of counsel for the Plaintiffs. Figure 6a displays the trend in the number of days when the heat index remains above 88 °F for more than 8 hours and 6b the trend in number of days per year when the heat index exceeds 95 °F for more than 8 hours. In both cases we see a positive trend in these extremes. The trend in the first plot is significant at the .07 level, but the trend in the second is not significant.



a.



b.

Figure 6. Time series and trend of number of days at College Station when the Heat Index (HI) exceeds a) 88 °F for more than 8 hours, and b) 95 °F for more than 8 hours.

5. *Expectations of climate change for this region of Texas, change in means and extremes of temperature, relative humidity, and heat index*

5.1 Uncertainties and certainties about future climate change.

In conducting my analysis, I have considered the potential uncertainties involved in climate change, but *none of them affect or call into question the clear scientific analysis indicating that future temperatures will increase in this region.* Regarding future climate, there are three main types of uncertainty.

5.1.1 One is the amount of greenhouse gases that will be emitted into the atmosphere in the future. This will be determined by how the entire world develops economically, politically, socially, technologically, etc. To represent this uncertainty, different scenarios of future emissions are developed based on making different assumptions about how the world will develop.

5.1.2 Another uncertainty is how the Earth's climate responds to the increasing concentrations of greenhouse gases in the atmosphere. The climate is a very complicated system, and the different parts of the system interact in complex ways. The main components of the system include the atmosphere, the land surface, the oceans, sea ice, and land ice (glaciers). This complex system is studied using large complex computer models that simulate the entire climate system, which are widely accepted as reliable in the field of climate science. There are a number of different models that are used, and to explore the uncertainty about how the Earth system will respond to increased greenhouse gases, a collection of simulations from different models are analyzed. A couple of these collections developed in conjunction with the IPCC, are referred to as CMIP3 (Climate Model Intercomparison Project 3, for the Fourth Assessment Report) and CMIP5 (for the Fifth Assessment Report.

5.1.3 The natural variability of the climate system will of course also continue in the future, such as the year-to-year variability of temperature. The upward trend in temperature will continue, but variability from year-to-year will also continue to occur. For example, the temperature in the summer of 2011 for Texas was record breaking, but the temperature in 2012 was not as hot. Yet the trend of summer temperatures at College Station is still towards warmer temperatures (see Figure 3).

Also, these different uncertainties are more or less dominant depending on how far into the future one looks. In the near term (next 20 years or so), the main uncertainty is the natural variability; as we look further into the future (i.e., mid-century), the uncertainty of the response of the climate system (represented by using different climate models) dominates; and in the far long term (e.g., beyond 2070) the different emissions or concentration scenarios become most important (Hawkins and Sutton, 2009) (see Figure 7).

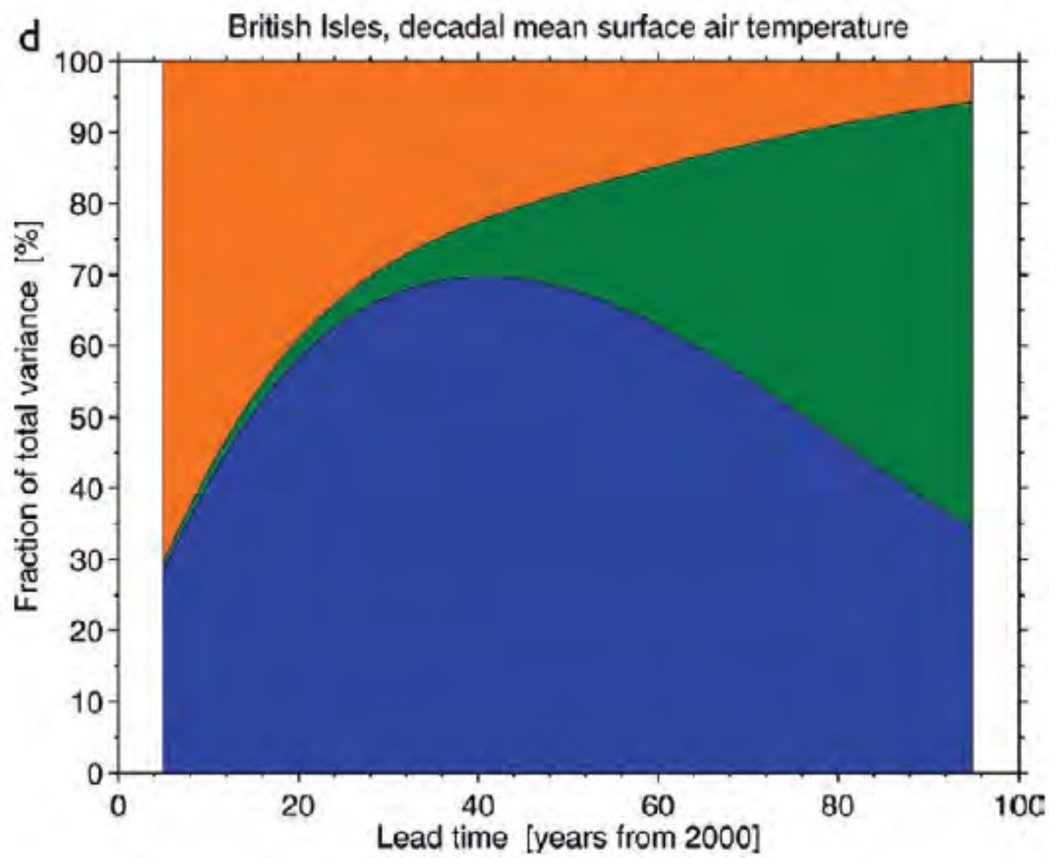


Figure 7. Relative importance of the different sources of uncertainty regarding climate change on a regional scale (here, the British Isles) based on evolving lead times. The time period mainly considered in this report is mid-21st century when the uncertainty due to using different climate models (blue) is dominant. Orange = uncertainty due to natural variability, and green = uncertainty due to future emissions of greenhouse gases. (Adapted from Hawkins and Sutton, 2009, Figure 4d).

This being said, *there is, however, a great deal of agreement and certainty about how some aspects of the climate system will evolve. This includes increases in temperature over virtually all land areas and resultant increases in the frequency of extreme high temperature events* as well as heat waves, that is series of days with very high temperatures (see section 2 above). It is also anticipated that changes in relative humidity will be relatively conservative, but that some drying of a few percentage points is likely to occur by the end of the 21st Century (Sherwood and Fu, 2015). This projection is consistent with the observed trend discussed above. There is agreement and reasonable certainty that this part of Texas would be expected to see a decrease of about 5 percentage points for annual average relative humidity by the end of the 21st century, and possibly a slightly larger decrease in the summer. Decreases by the mid-part of the century would be smaller.

5.2 Results from the most recent IPCC Report

The most recent IPCC report in the Annex 1 (IPCC, 2013b) displays maps of climate change for all regions of the world and includes simple measures of uncertainty (i.e., displaying the 25th, 50th, and 75th percentiles of the model results). About 40 different global climate models were used to calculate these values (the CMIP5 collection of global climate model simulations). The degree of summer mean temperature change for the period 2016-2035 and 2046-2065 for the RCP8.5 scenario is examined by inspection. The RCP8.5 scenario is similar to the A2 scenario used in the NARCCAP regional climate model experiments, and are thus comparable particularly for the time period in the middle of the 21st century (see section 5.4 below). However, here global climate model results are being examined. For the region containing Navasota Texas, the median summer mean temperature changes are 2.25 °F [25th to 75th quantiles (interquartile range): 1.8 – 4.5 °F] for the earlier time period and 4.5 °F [range 3.6 – 6.3 °F] for the later time period. While these changes may not seem large, note that this is a summer mean temperature value, and extremes would change a good deal more than this (see Figure 1).

5.3 Results from the US National Climate Assessment (NCA) Report

Based on the most recent US Climate Change Assessment (Mellilo et al., 2014), the region of Texas containing Navasota is expected to increase in mean annual temperature between 4.5 and 8.5 °F by the end of the 21st century. With newer estimations of future greenhouse gas emissions and resulting concentrations (based on the CMIP5 model results), the expectation is 3.5 to 8.5 °F. Note, however, that these estimates are for the end of the 21st century, not the middle time period (~2055) that was reported in section 5.2 above and will be discussed in section 5.4 below.

5.4 Results based on our detailed analyses of NARCCAP data.

The North American Regional Climate Change Assessment Program (NARCCAP) produced a set of high-resolution future climate simulations, which is one of three sets of future climate simulations used in the 2014 U.S. National Climate Assessment. It was also used in several of the regional reports particularly for looking at extreme events (e.g., number of days above 95 °F for the Southwest (Garfin et al., 2013). It is a higher resolution data set because the models used are regional climate models that simulated the climate at a higher resolution (about 30 miles) than is usual for global climate models (typically at about 100 – 150 miles). Higher resolution simulations in general pick up more details about the change in climate over space, and this also improves the model's ability to produce extreme events (e.g., temperature extremes). The NARCCAP data set includes regional climate model (RCM) simulations at 50 km (30 miles) spatial resolution over North America for a recent historical time period (1971-2000) and then a time period in the middle of the 21st century (2041-70) with a relatively high greenhouse gas

emissions scenario, A2 (Mearns et al., 2009; 2013). It should be noted that this relatively high emissions scenario is the path we are currently on. The RCMs are driven by several different global climate models at the RCMs' domain boundaries. This suite of climate change scenarios was used in the recently published hi-profile article (Jones et al., 2015), which presented an analysis of future extreme temperatures along with shifts in population density that would affect human health due to heat stress. While a closer time period might be desirable for some purposes, the advantage of looking at the middle of the 21st century is that the signal of climate change is clearer (i.e., it emerges more clearly against the background of natural variability). However, at that future point in time, the uncertainty due to future emissions scenarios is not yet dominant (see Figure 7). Twelve different simulations of the current and future were performed. (However, in two of the simulations the relative humidity results were problematic due to faulty interpolation to 2-m heights from the lowest model level). We present here information on the changes in temperature for the 12 simulations and humidity for the 10 simulations as well as future heat index compared to the current in 2035 and 2055 for the region including Navasota, specifically for College Station. Results from the grid box of the regional climate models covering this area (~30 miles by 30 miles) are used. All NARCCAP data are freely available at: http://www.narccap.ucar.edu/.

Note that temperature change through time in the 21st century will be monotonic (increasing, but with year-to-year variability), and if desired one could extrapolate backward to an earlier time period to get a sense of possible outcomes for that future period (Easterling et al., 2003). I decided to apply this method and extrapolate back linearly to a date of roughly 2035, by halving the climate changes found for the 2041-2070 time period (centered at 2055). Figure 8 shows the change in mean summer temperature and relative humidity for the 12 different regional climate model experiments.

5.4.1 Future temperatures

Changes in mean temperature for the warm months (May – October) calculated from the 12 RCMs are displayed in Figure 8 (upper panel). The range of model results represents the 'structural' uncertainty in future climate due to the different climate models' representation of the climate system. This is the dominant kind of uncertainty present in the mid-21st century.

I also determined the likelihood of recurrence of extreme summer temperatures at the level of the summer of 2011 at College Station. Taking the record period we considered (1973-2013), and assuming a normal distribution (appropriate for seasonal means) the likelihood of the summer temperature of 2011 was 1% (.01).[3] For the earlier future period (2035) the mean likelihood is 8%, or an eight-fold

[3] The advantage of using inferential statistics in this case (i.e., using all the data to establish the appropriate distribution) is that results will be more robust than when using descriptive statistics to establish a sample quantile.

increase, with the range across the 12 climate change scenarios of 4% to 17%. By the mid-century (2055) this likelihood increases on average to 33%, a 33-fold increase (range: 12% to 67%.)

5.4.2 Change in relative humidity

Based on recent research (Sherwood and Fu, 2015) the relative humidity in this part of the world is generally expected to decrease, but not by much. The results for the NARCCAP simulations are largely consistent with this result and are exhibited in Figure 8 (lower panel) showing change in monthly mean relative humidity for ~2055 for warm season months. Mean change of the model simulations for summer is about -3 percentage points with a range across the models of about ±4 percentage points (Figure 8 lower panel). Consistent with the results of Sherwood and Fu (2015), we see mainly small decreases in relative humidity as we move into the future. For example for July, the model mean change is about – 2 percentage points, and the range across the models is from -7 to +2.5 percentage points.

5.4.3 Future Heat Index at College Station

With only small changes in relative humidity and relatively large changes in temperature, the change in heat index will be dominated by the change in temperature in the future.

To create usable data sets for the two future time periods for temperature and relative humidity, the changes (future - current) in the simulations were calculated and then combined with the observed data sets. Specifically, on a monthly time scale, temperature change (°F) is added to the observed hourly temperature time series. Similarly the monthly changes in relative humidity (percentage points) are added to the hourly relative humidity values of the observed data. This procedure, known as the 'delta approach' has been a standard means of creating climate change datasets for use in determining the impact of climate change (Mearns et al., 2001). The raw climate model data are not used directly because of biases in the data. For the two modeling experiments for which the relative humidity values were not available, we used the mean values from the other 10 experiments. We mainly consider the number of hours per day when extremes of the heat index are obtained. Specifically I looked at three extreme heat index values: 88, 95, and 100 °F. I calculated the frequency of days with greater than 4 and 8 hours per day with HI > 95, 100 °F as shown in Figure 9. Note that for 100 °F heat index for greater than 8 hours, the current level is very low, 3 days. By 2035, the median value goes up to over 20 days, and by 2055, the median exceeds 55 days.

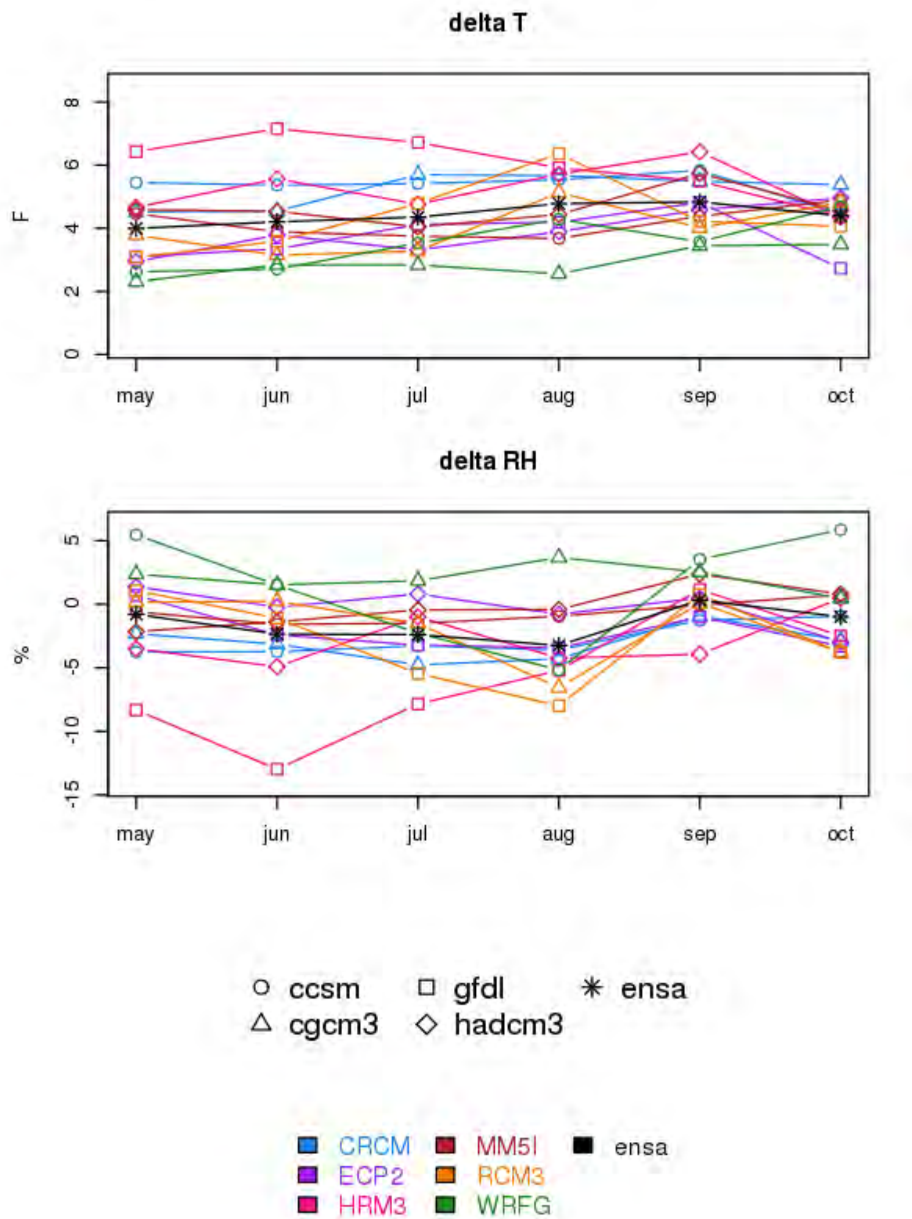
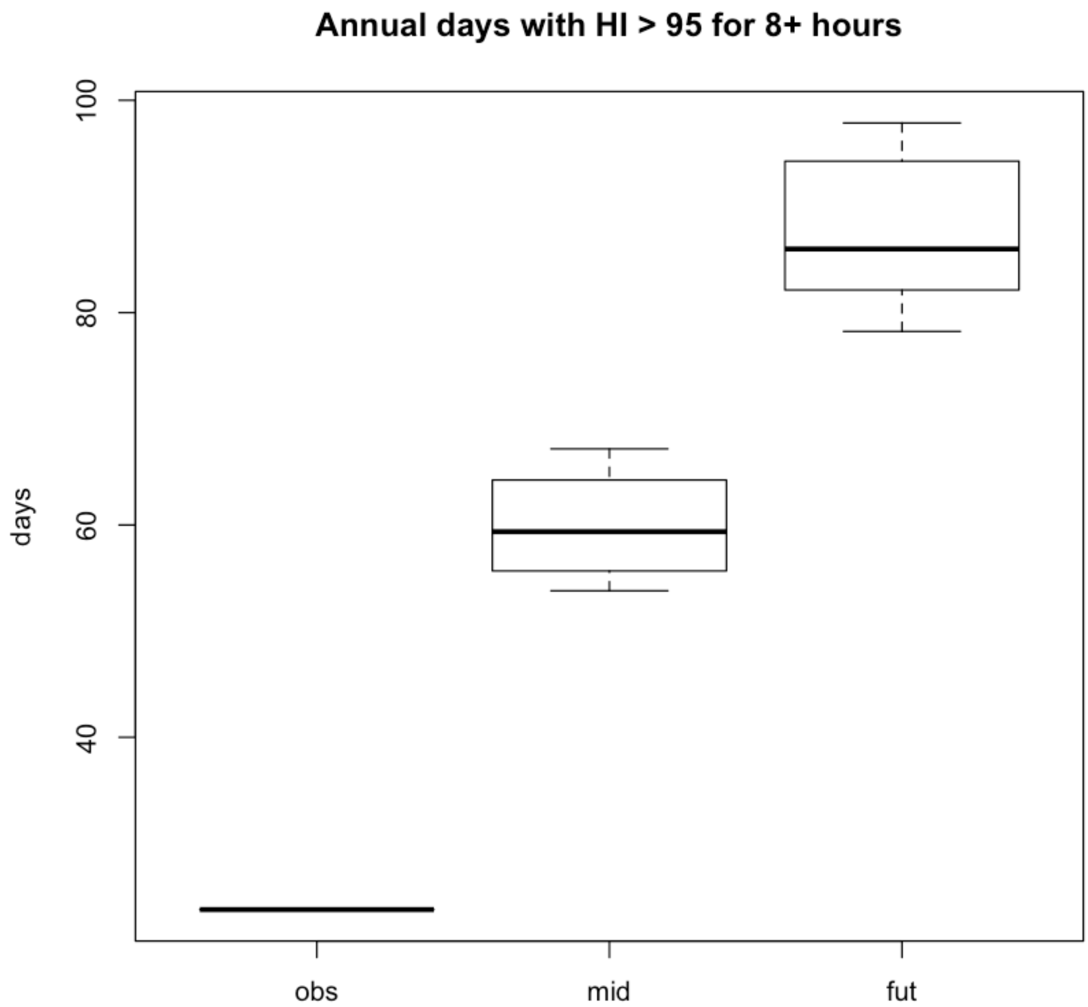


Figure 8. Change (delta) in mean temperature °F (top) and mean relative humidity (percentage points) (bottom) for the months specified for the 12 regional climate model experiments. Symbols indicate in color the 6 different regional climate models; these are paired with the global models that drove the regional models, with certain combinations selected to produce 12 experiments. For example, the pink square symbol represents the HRM3 regional climate model driven by the GFDL global climate model. Ensa = the ensemble average.


Annual days with HI > 95 for 8+ hours
days
100
80
60
40
obs
mid
fut

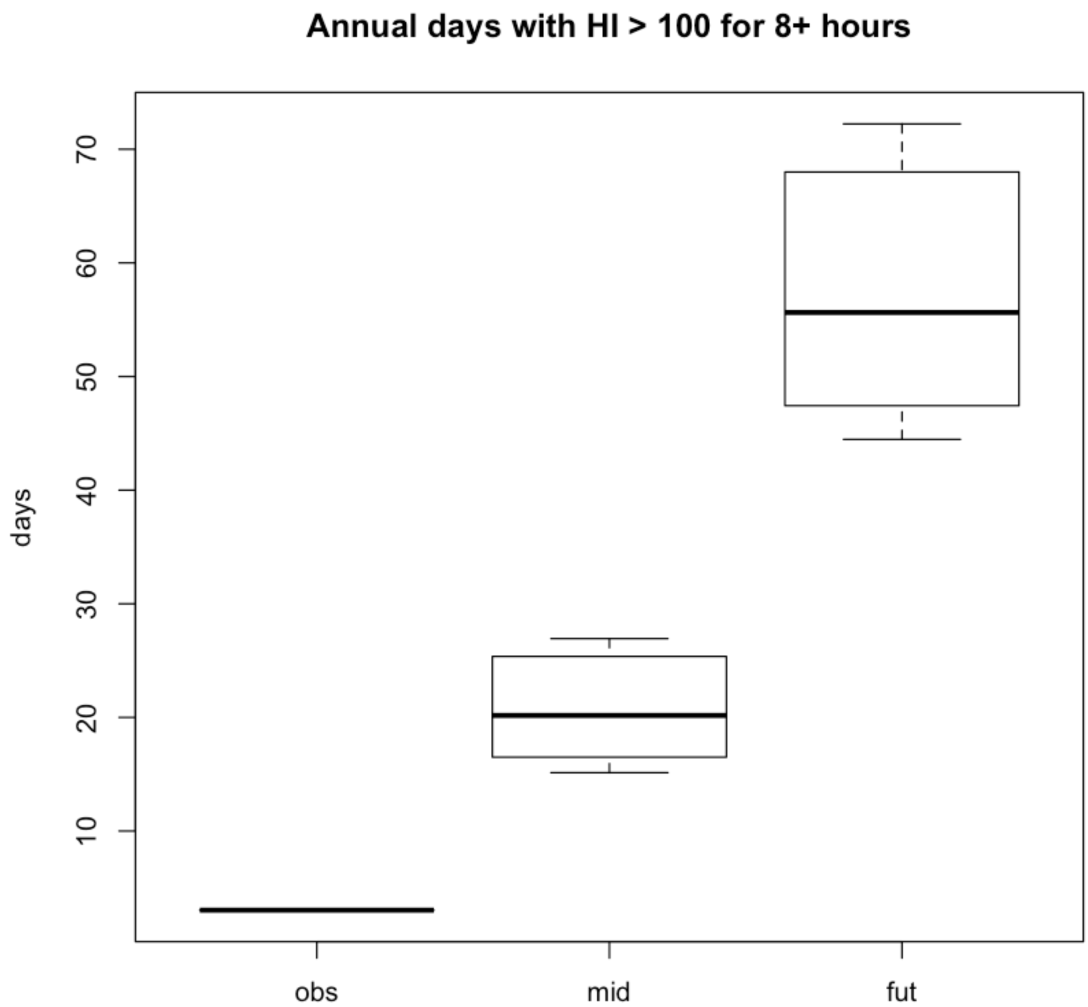


Figure 9. Box plots of total number of days per year when the heat index exceeds 95 °F (top panel) or 100 °F (bottom panel) for more than 8 hours for the current (from observations, 'obs'), 2035 (mid) and 2055 (fut). Box plots display the distribution of the number of days of the particular heat index values obtained from applying the 12 different climate change cases. The thick line in the middle is the median value. The bottom and top edges of the boxes are the 25th and 75th quantiles of the results, and the ends (smaller horizontal lines) indicate the largest and smallest values of the 12 numbers. For 'obs', observations, there is only one value, rather than a distribution.

6.0 Concluding Comments

While there are uncertainties regarding future climate change, increasing temperatures and increasing extreme temperatures and heat waves are among the most certain expectations about future climate, and this applies to the region of Texas containing Navasota. This most likely will result in an increasing heat index, and number of hours per day with extreme heat index values. The expected small decreases in relative humidity will be offset by relatively large increases in temperature.

I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct.

Executed this twenty-second day of October 2015, in Boulder, Colorado

Linda O. Mearns

Linda O. Mearns, Ph.D.

Appendix 1: References

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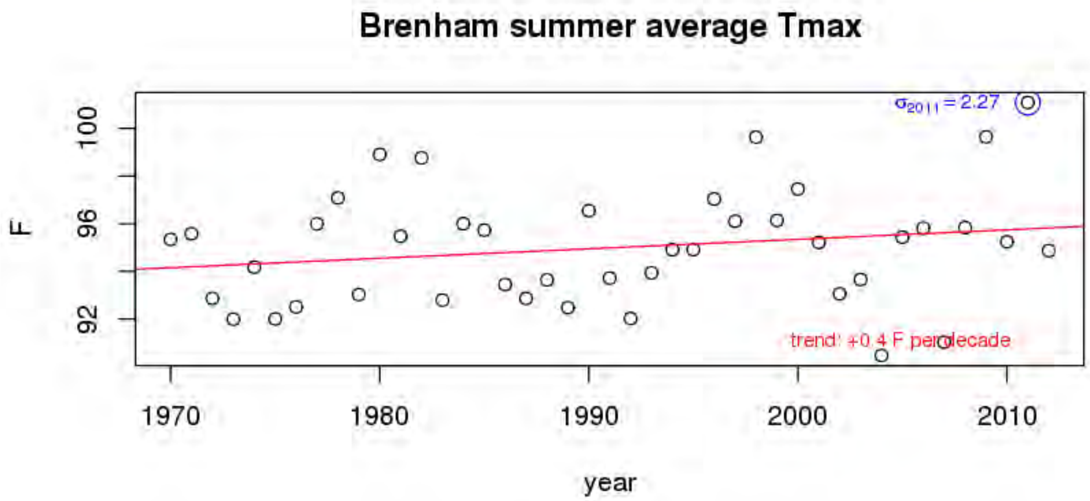
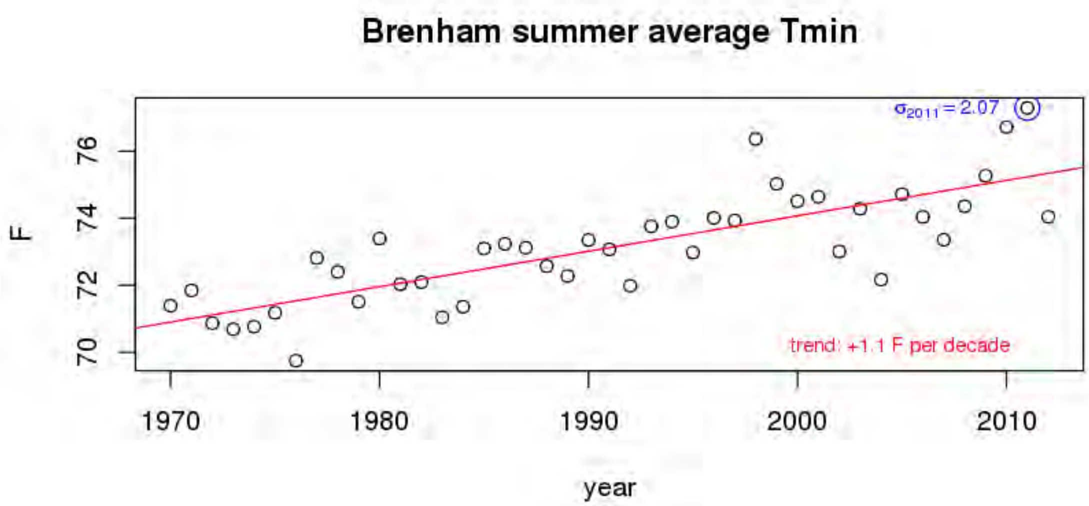
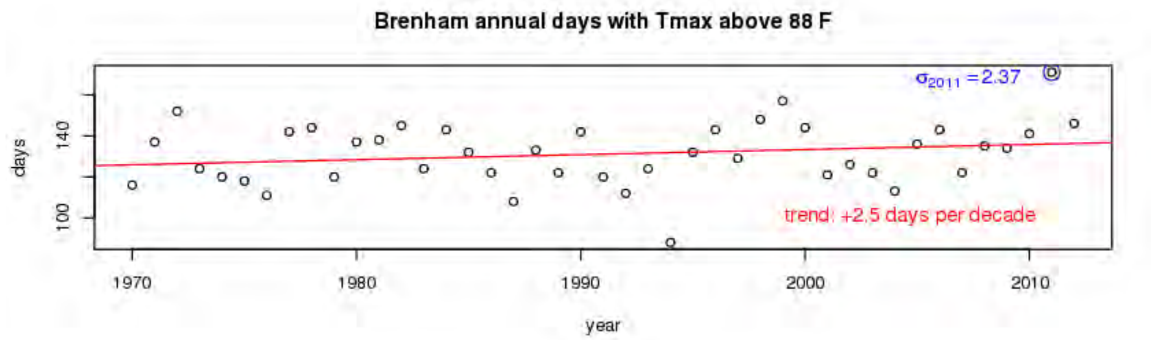
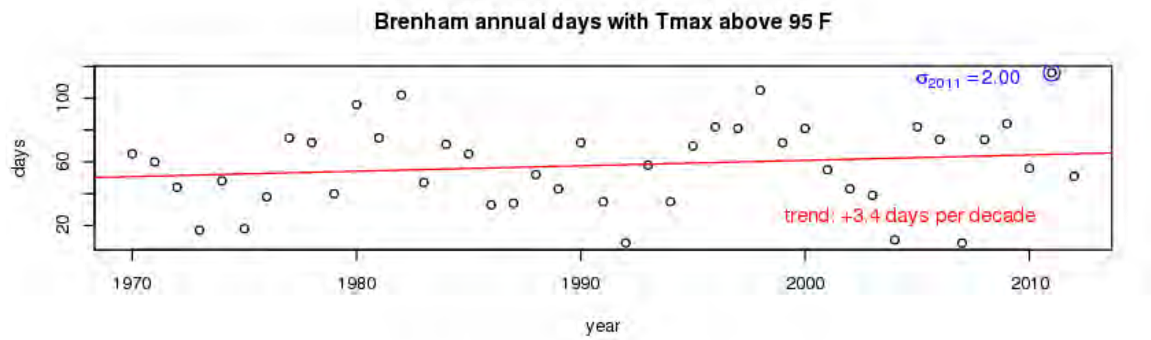
Appendix 2: Additional Figures

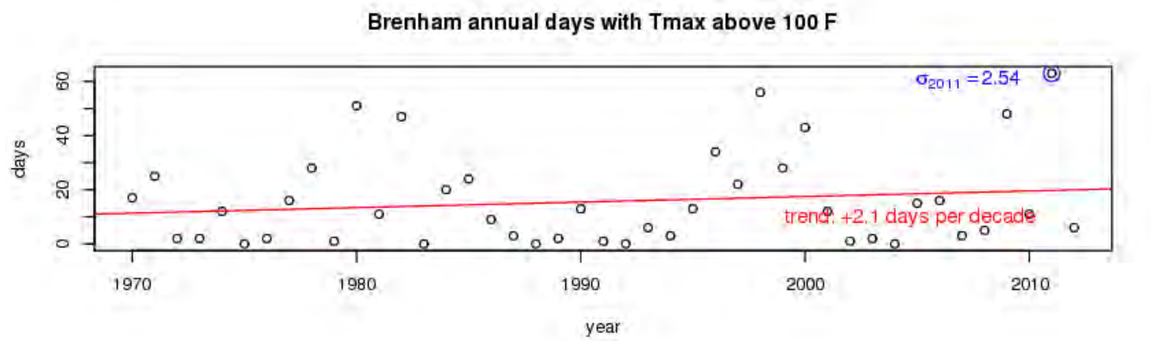
Figures are presented for the 5 other stations not presented in the body of the report. Figures are ordered by station, with time series and trends in maximum and minimum mean summer temperatures, and time series and trends in daily temperatures exceeding 88, 95 and 100 °F. Following these are figures concerning other thresholds of the observed HI at College Station. Finally the last four figures are box plots for other HI thresholds at College Station for future conditions.

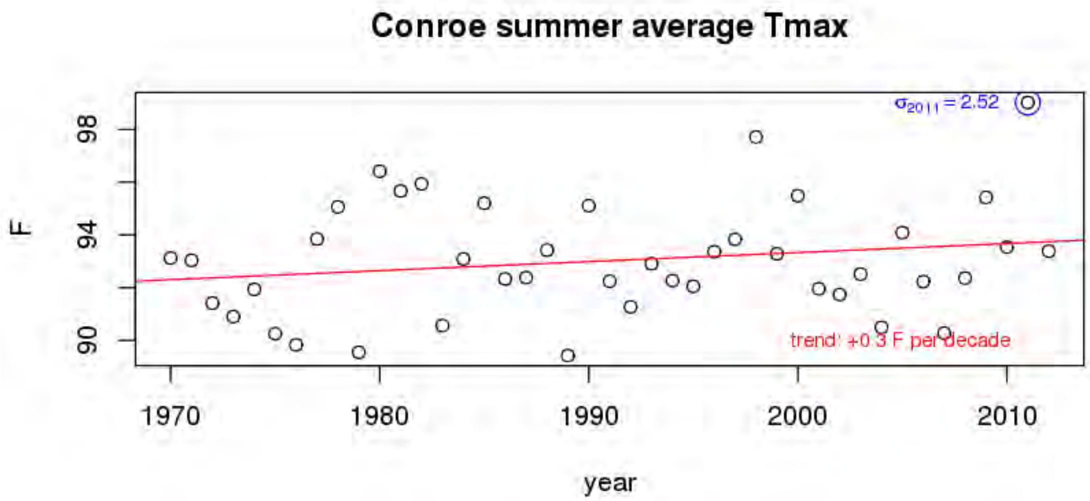

Brenham summer average Tmax
σ2011 = 2.27
trend: +0.4 F per decade
F
92
96
100
1970
1980
1990
2000
2010
year


Brenham summer average Tmin
σ2011 = 2.07
trend: +1.1 F per decade
F
70
72
74
76
1970
1980
1990
2000
2010
year

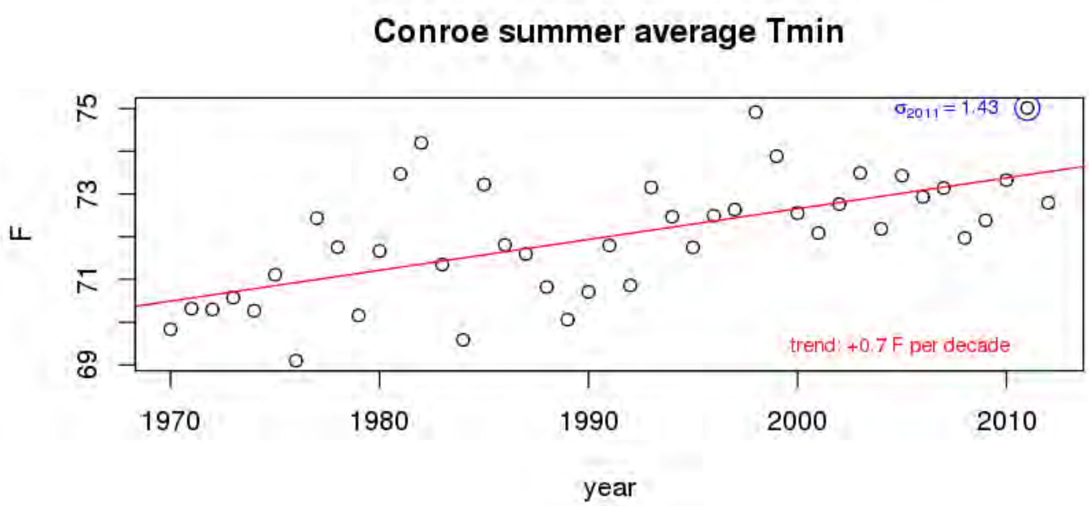

Brenham annual days with Tmax above 88 F
σ_{2011} = 2.37
trend: +2.5 days per decade
days
100
140
1970
1980
1990
2000
2010
year


Brenham annual days with Tmax above 95 F
σ_{2011} = 2.00
trend: +3.4 days per decade
days
20
60
100
1970
1980
1990
2000
2010
year

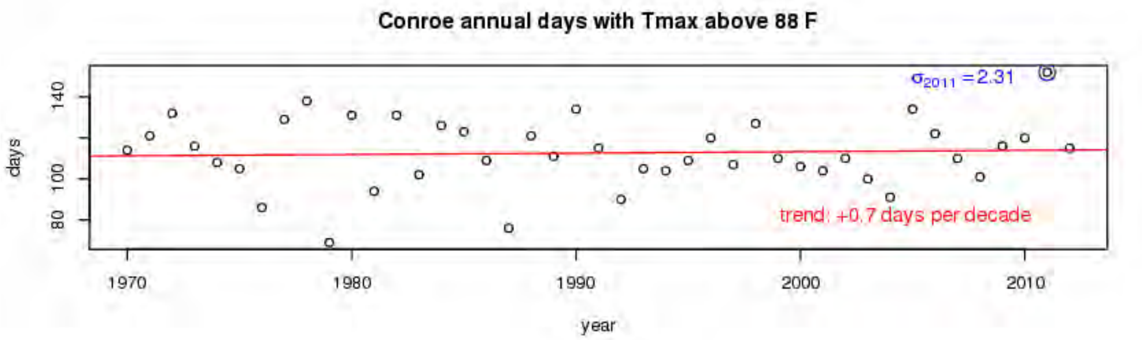

Brenham annual days with Tmax above 100 F
σ_{2011} = 2.54
trend: +2.1 days per decade
days
0
20
40
60
1970
1980
1990
2000
2010
year

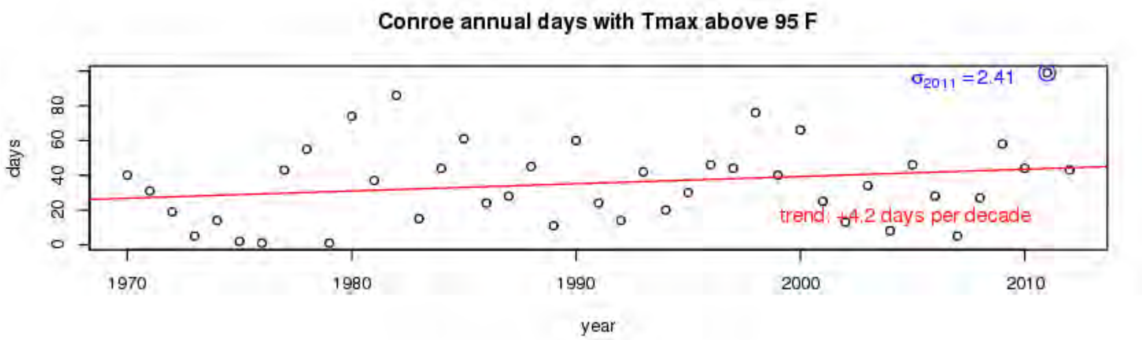


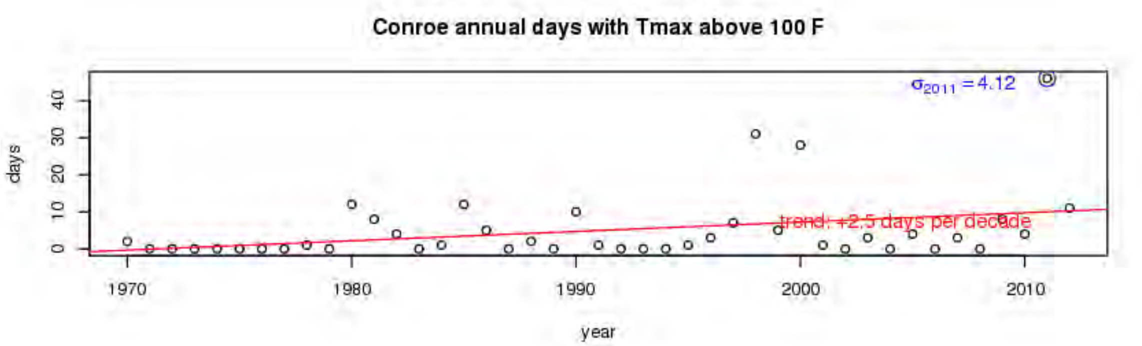
Conroe summer average Tmax
$\sigma_{2011} = 2.52$
98
94
90
F
trend: +0.3 F per decade
1970
1980
1990
2000
2010
year

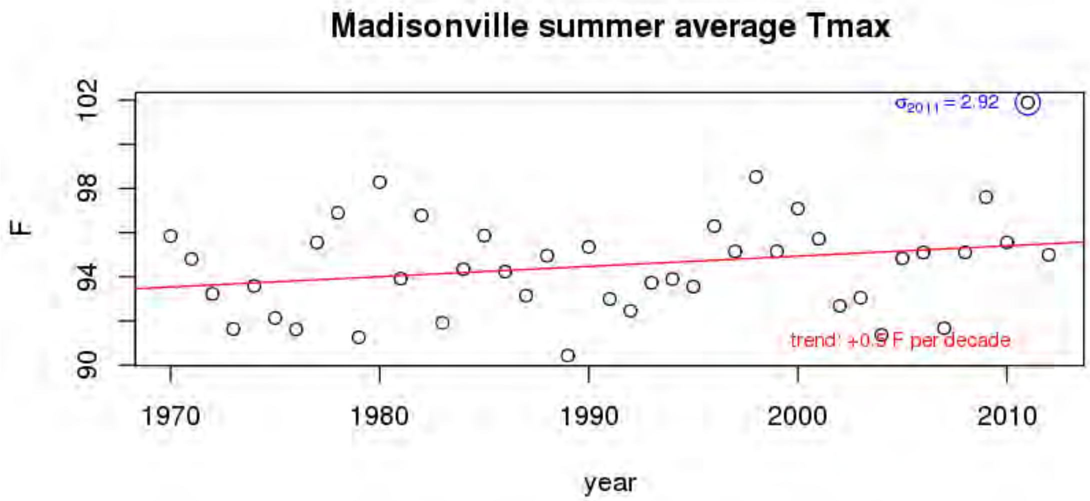


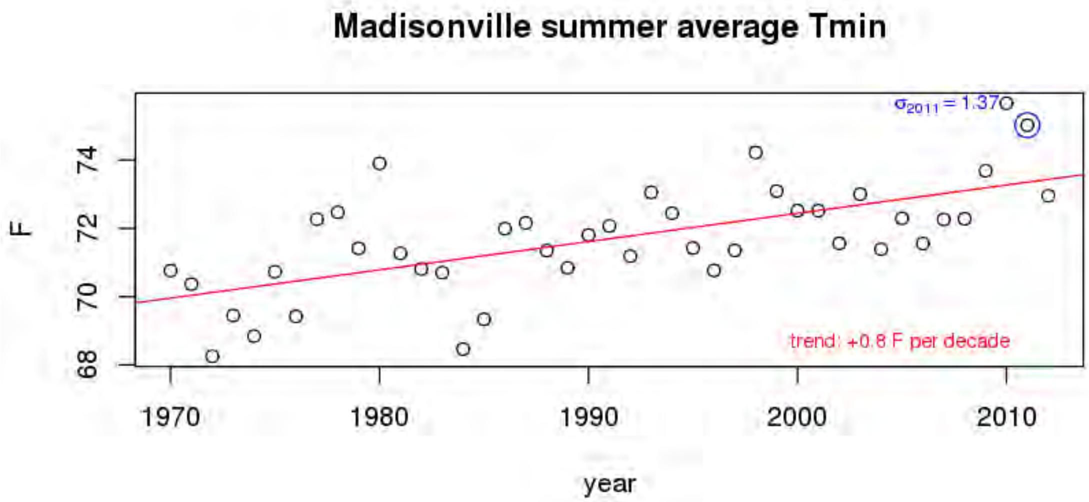
Conroe summer average Tmin
$\sigma_{2011} = 1.43$
75
73
71
69
F
trend: +0.7 F per decade
1970
1980
1990
2000
2010
year

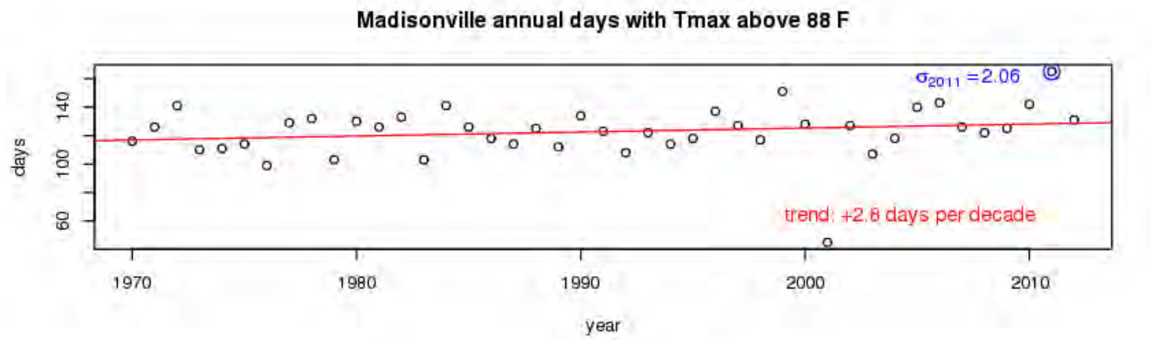

Conroe annual days with Tmax above 88 F
σ_{2011} = 2.31
trend: +0.7 days per decade
days
year
80
100
140
1970
1980
1990
2000
2010


Conroe annual days with Tmax above 95 F
σ_{2011} = 2.41
trend: +4.2 days per decade
days
year
0
20
40
60
80
1970
1980
1990
2000
2010


Conroe annual days with Tmax above 100 F
σ_{2011} = 4.12
trend: +2.5 days per decade
days
year
0
10
20
30
40
1970
1980
1990
2000
2010


Madisonville summer average Tmax
F
90
94
98
102
1970
1980
1990
2000
2010
year
$\sigma_{2011} = 2.92$
trend: +0.5 F per decade


Madisonville summer average Tmin
F
68
70
72
74
1970
1980
1990
2000
2010
year
$\sigma_{2011} = 1.37$
trend: +0.8 F per decade


Madisonville annual days with Tmax above 88 F
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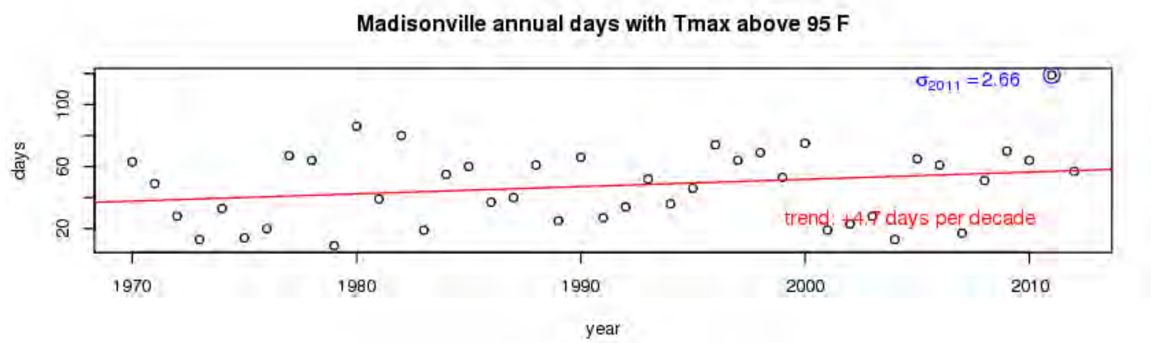
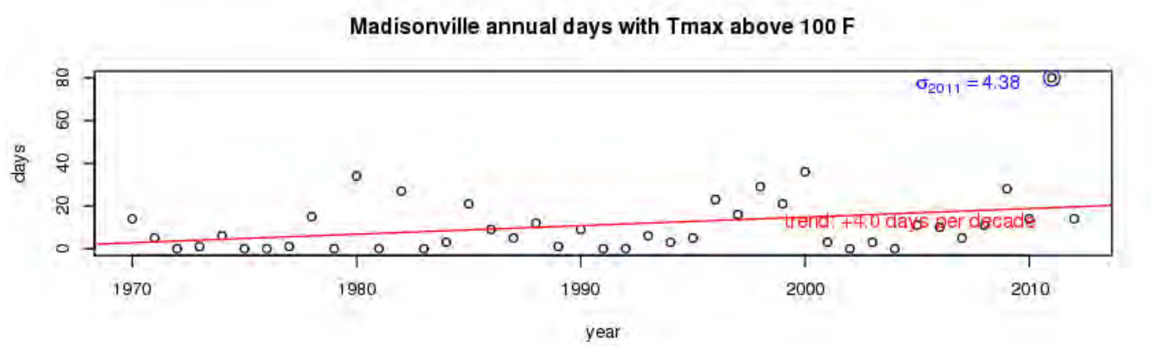
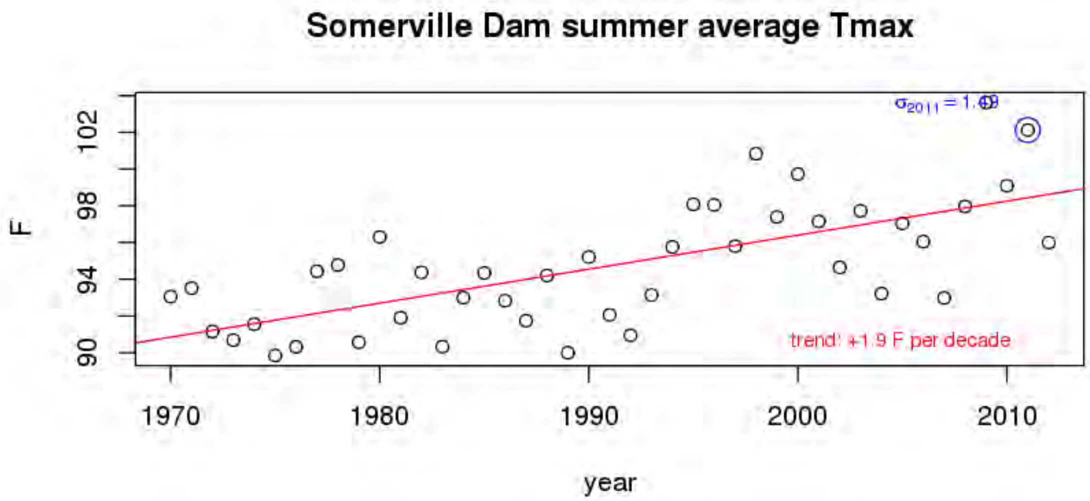
trend: +2.8 days per decade
days
60
100
140
1970
1980
1990
2000
2010
year


Madisonville annual days with Tmax above 95 F
$\sigma_{2011} = 2.66$
trend: +4.7 days per decade
days
20
60
100
1970
1980
1990
2000
2010
year


Madisonville annual days with Tmax above 100 F
$\sigma_{2011} = 4.38$
trend: +4.0 days per decade
days
0
20
40
60
80
1970
1980
1990
2000
2010
year


Somerville Dam summer average Tmax
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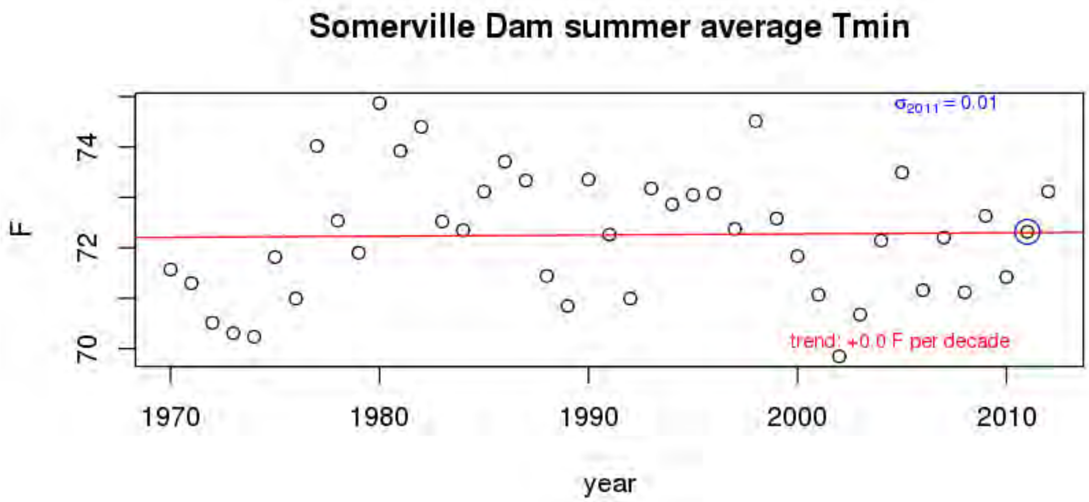
trend: +1.9 F per decade
F
90
94
98
102
1970
1980
1990
2000
2010
year


Somerville Dam summer average Tmin
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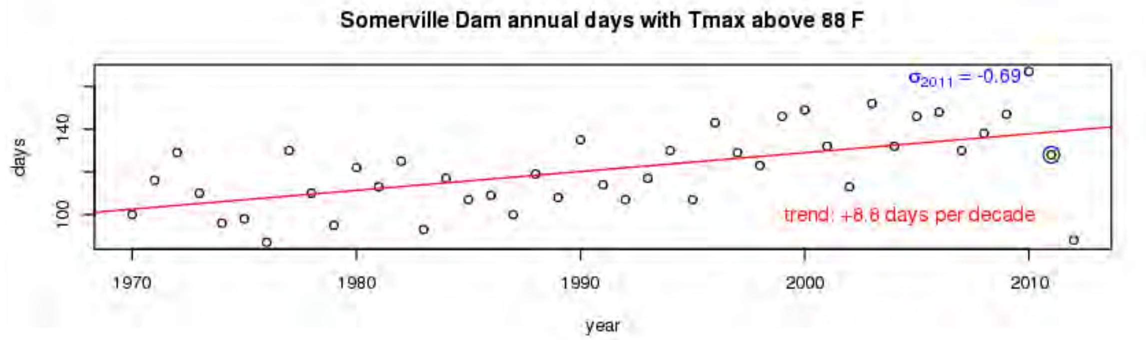
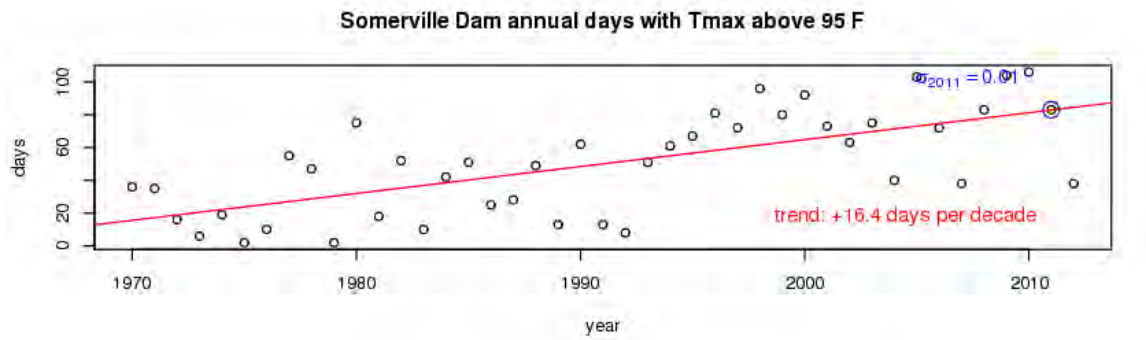
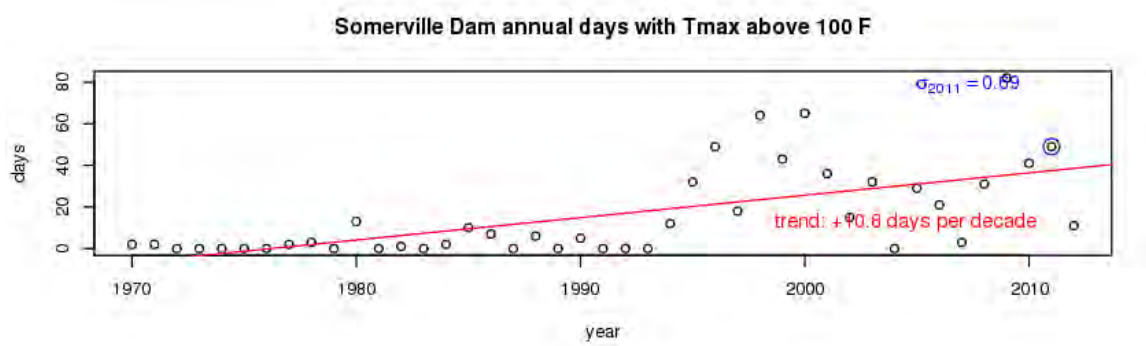
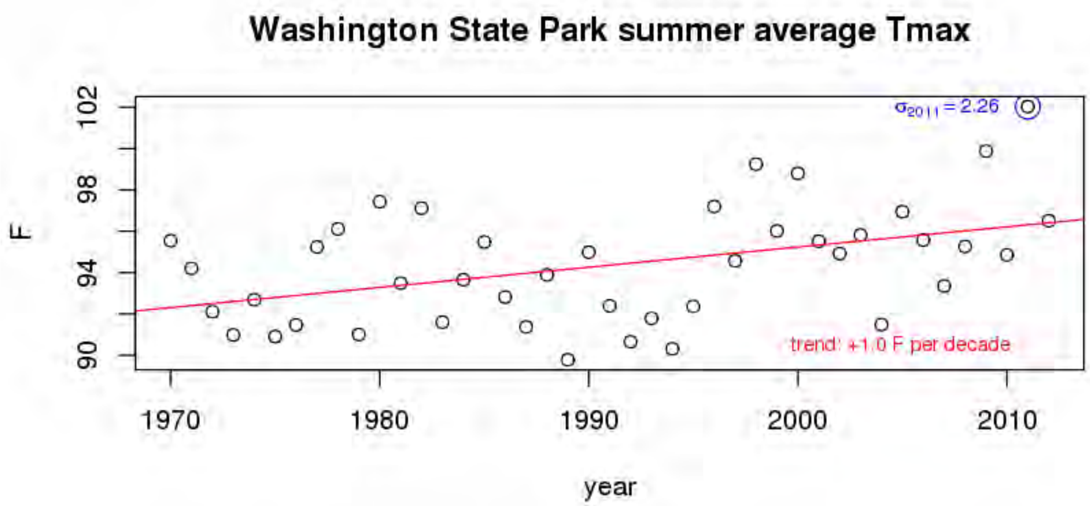
trend: +0.0 F per decade
F
70
72
74
1970
1980
1990
2000
2010
year

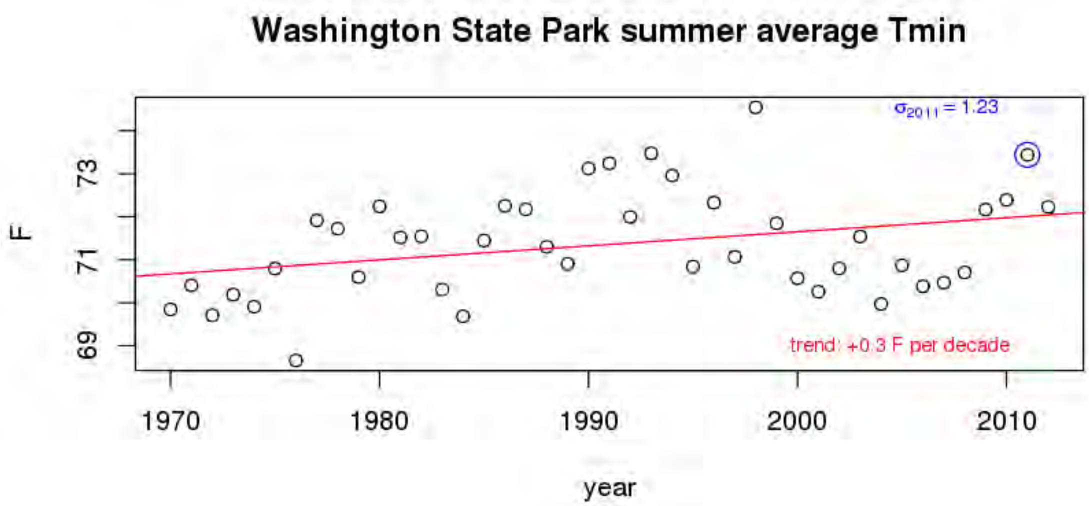

Somerville Dam annual days with Tmax above 88 F
days
year
σ_{2011} = -0.69
trend: +8.8 days per decade
100
140
1970
1980
1990
2000
2010


Somerville Dam annual days with Tmax above 95 F
days
year
σ_{2011} = 0.91
trend: +16.4 days per decade
0
20
60
100
1970
1980
1990
2000
2010

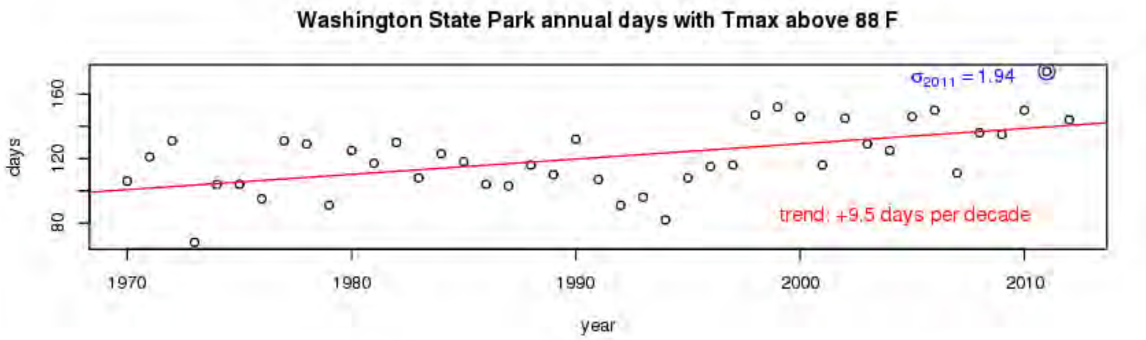

Somerville Dam annual days with Tmax above 100 F
days
year
σ_{2011} = 0.89
trend: +10.8 days per decade
0
20
40
60
80
1970
1980
1990
2000
2010



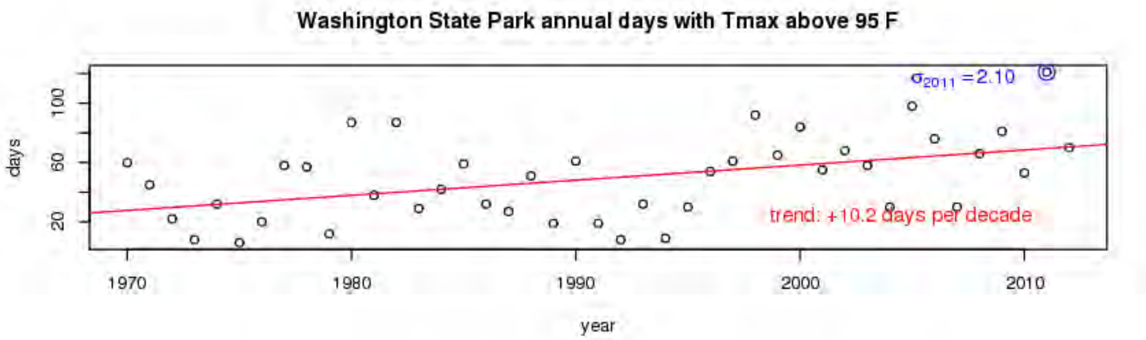
Washington State Park summer average Tmax
$\sigma_{2011} = 2.26$
trend: +1.0 F per decade
F
90
94
98
102
1970
1980
1990
2000
2010
year



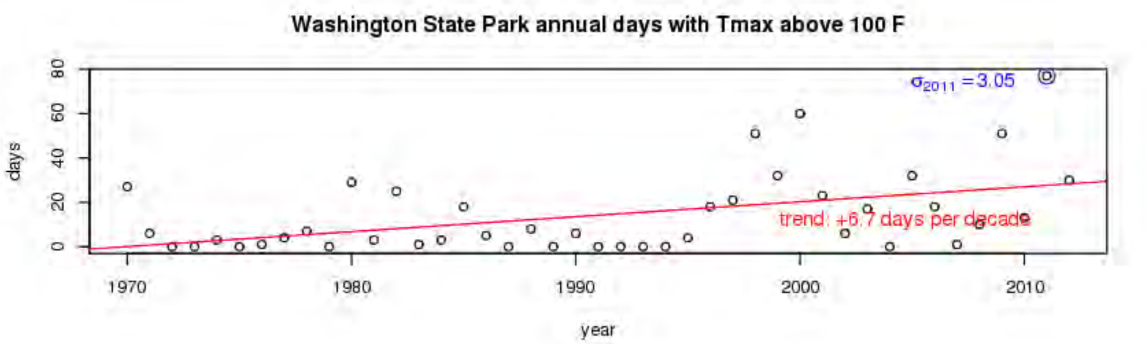
Washington State Park summer average Tmin
$\sigma_{2011} = 1.23$
trend: +0.3 F per decade
F
69
71
73
1970
1980
1990
2000
2010
year



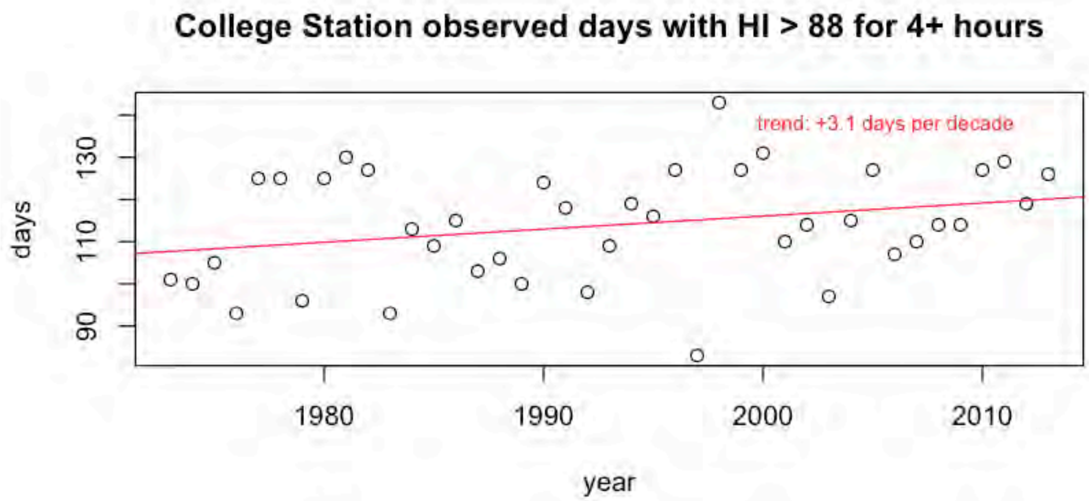
Washington State Park annual days with Tmax above 88 F
$\sigma_{2011} = 1.94$
trend: +9.5 days per decade
days
year

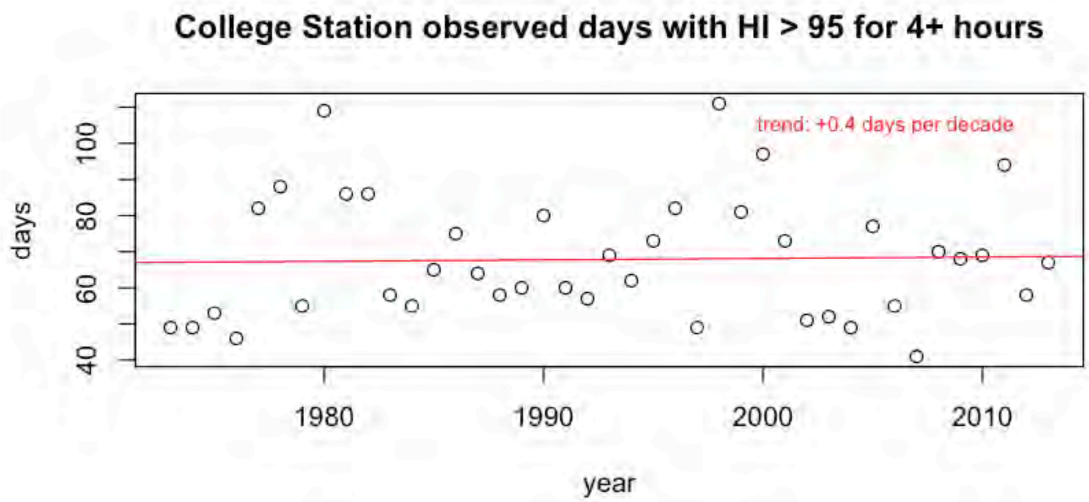


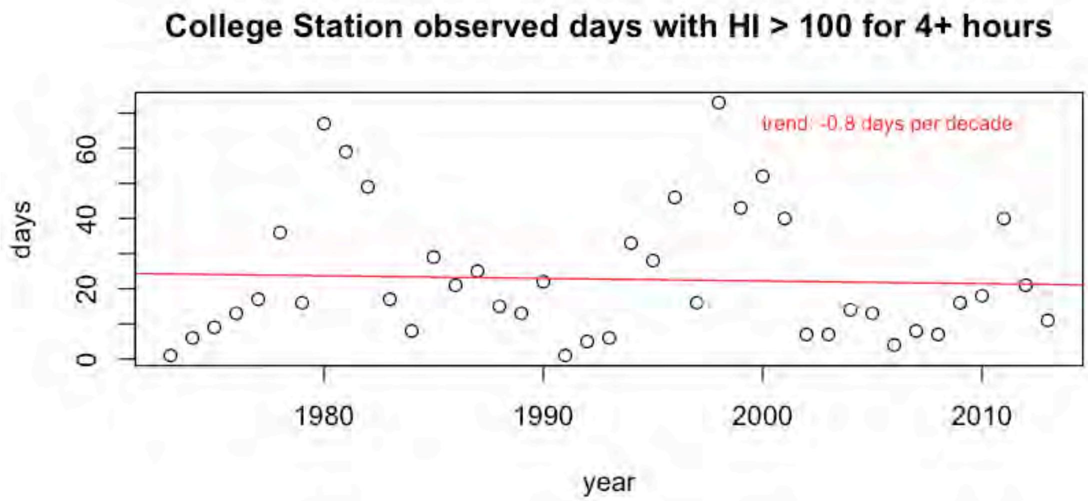
Washington State Park annual days with Tmax above 95 F
$\sigma_{2011} = 2.10$
trend: +10.2 days per decade
days
year

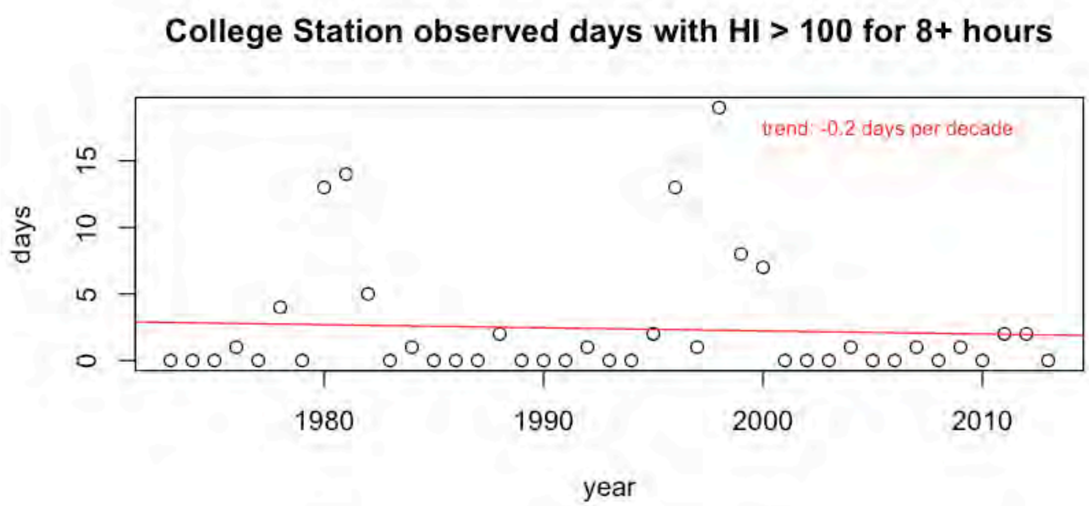


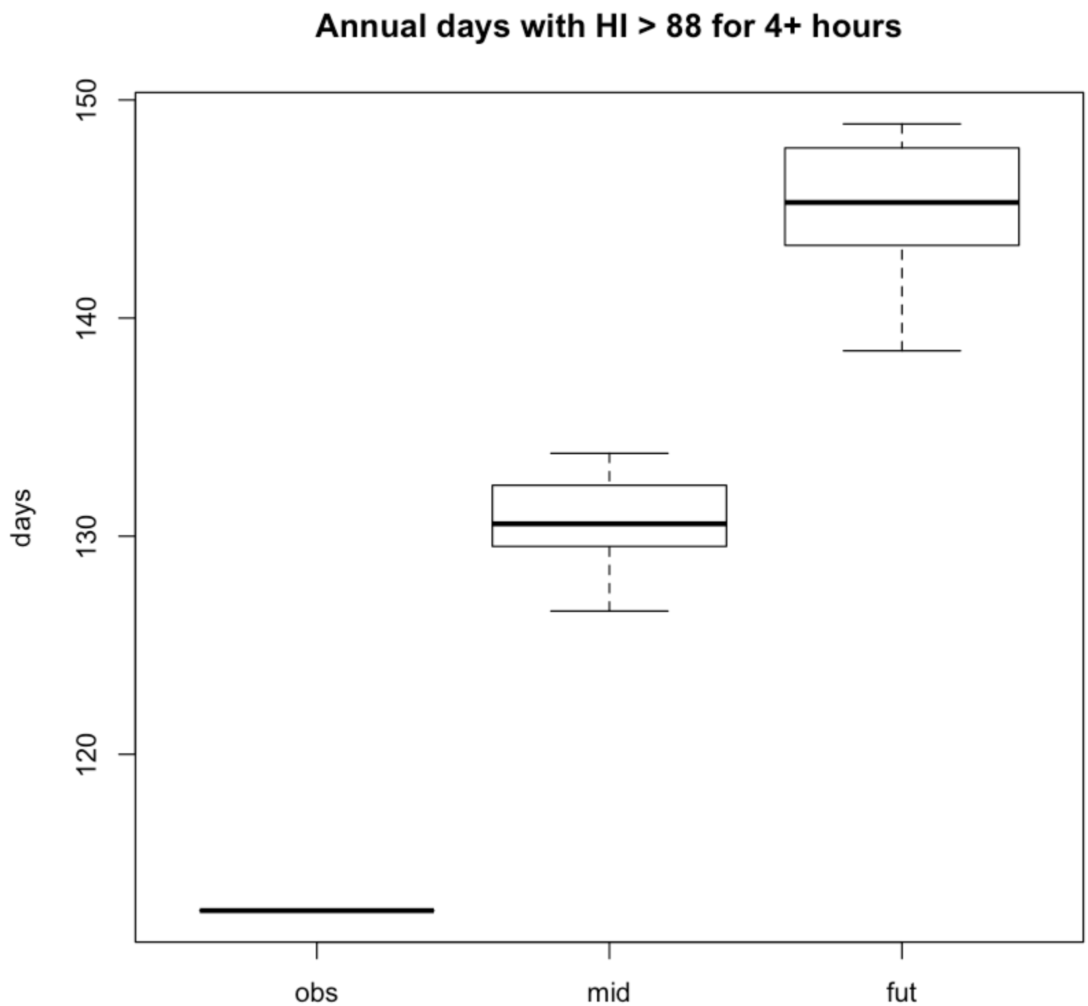
Washington State Park annual days with Tmax above 100 F
$\sigma_{2011} = 3.05$
trend: +6.7 days per decade
days
year

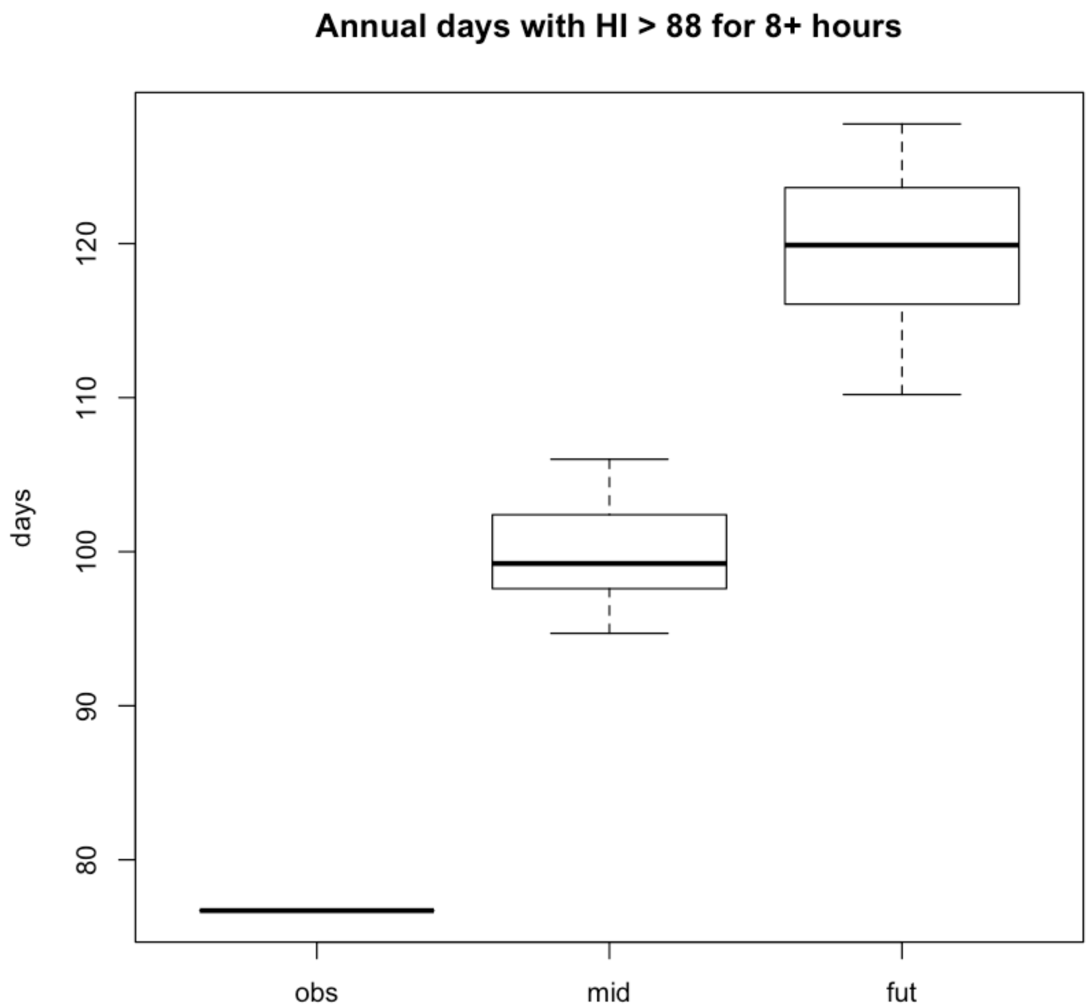

College Station observed days with HI > 88 for 4+ hours
trend: +3.1 days per decade
days
90
110
130
1980
1990
2000
2010
year

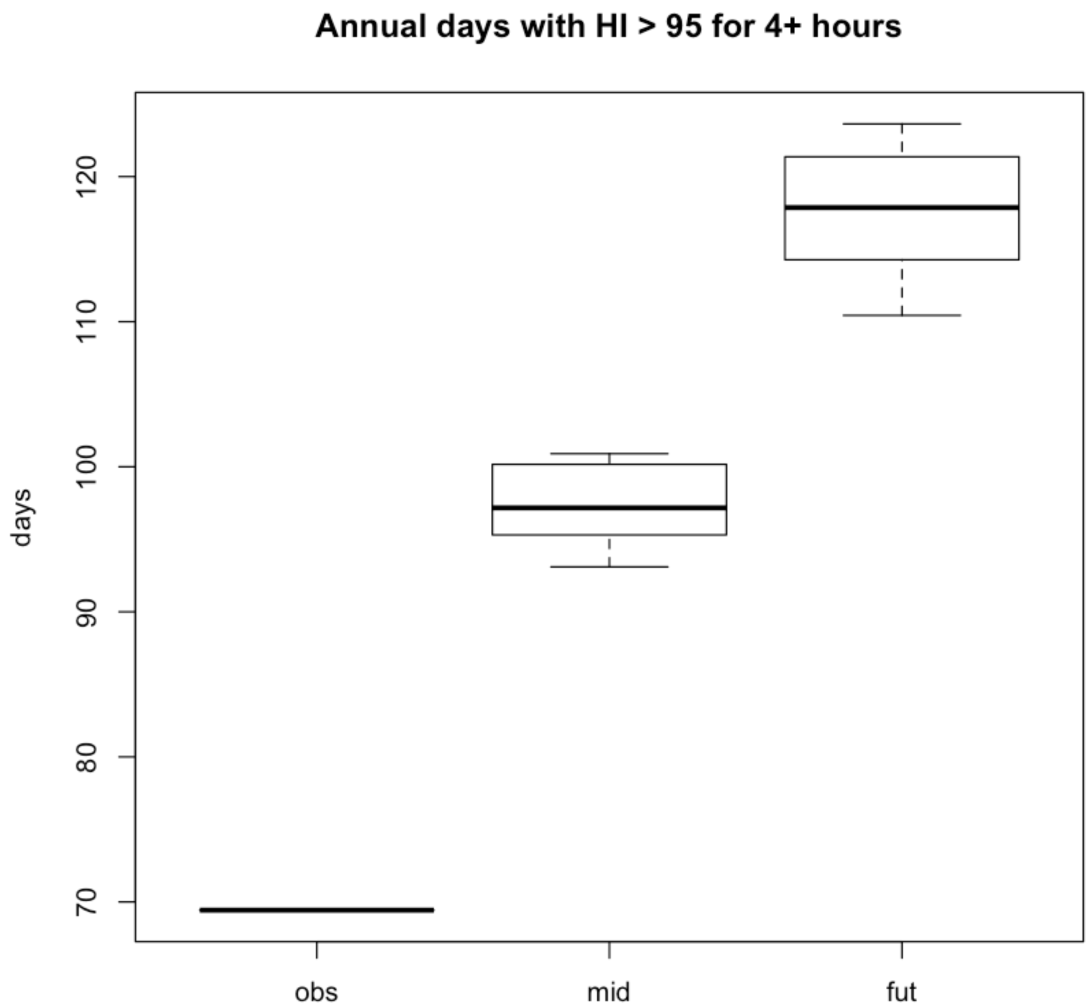

College Station observed days with HI > 95 for 4+ hours
trend: +0.4 days per decade
days
40
60
80
100
1980
1990
2000
2010
year


College Station observed days with HI > 100 for 4+ hours
trend: -0.8 days per decade
days
0
20
40
60
1980
1990
2000
2010
year


College Station observed days with HI > 100 for 8+ hours
trend: -0.2 days per decade
days
0
5
10
15
1980
1990
2000
2010
year


Annual days with HI > 88 for 4+ hours
days
150
140
130
120
obs
mid
fut


Annual days with HI > 88 for 8+ hours
days
80
90
100
110
120
obs
mid
fut



Annual days with HI > 95 for 4+ hours
days
70
80
90
100
110
120
obs
mid
fut

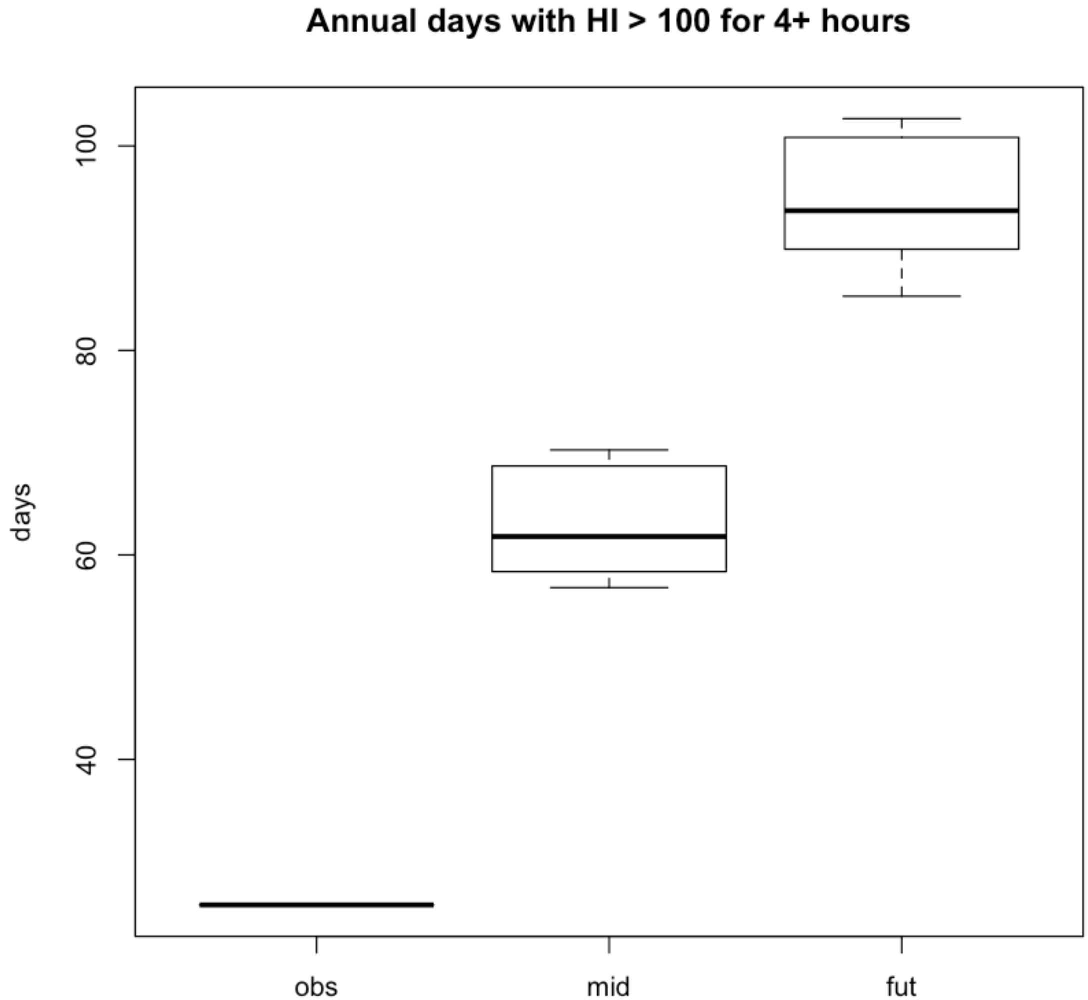

Annual days with HI > 100 for 4+ hours
days
100
80
60
40
obs
mid
fut

Exhibit 5

The Heat Index Equation

The computation of the heat index is a refinement of a result obtained by multiple regression analysis carried out by Lans P. Rothfusz and described in a 1990 National Weather Service (NWS) Technical Attachment (SR 90-23). The regression equation of Rothfusz is

$$HI = -42.379 + 2.04901523*T + 10.14333127*RH - .22475541*T*RH - .00683783*T*T - .05481717*RH*RH + .00122874*T*T*RH + .00085282*T*RH*RH - .00000199*T*T*RH*RH$$

where **T** is temperature in degrees F and **RH** is relative humidity in percent. **HI** is the heat index expressed as an apparent temperature in degrees F. If the **RH** is less than 13% and the temperature is between 80 and 112 degrees F, then the following adjustment is subtracted from **HI**:

$$ADJUSTMENT = [(13-RH)/4]*SQRT\{[17-ABS(T-95.)]/17\}$$

where **ABS** and **SQRT** are the absolute value and square root functions, respectively. On the other hand, if the **RH** is greater than 85% and the temperature is between 80 and 87 degrees F, then the following adjustment is added to **HI**:

$$ADJUSTMENT = [(RH-85)/10] * [(87-T)/5]$$

The Rothfusz regression is not appropriate when conditions of temperature and humidity warrant a heat index value below about 80 degrees F. In those cases, a simpler formula is applied to calculate values consistent with Steadman's results:

$$HI = 0.5 * \{T + 61.0 + [(T-68.0)*1.2] + (RH*0.094)\}$$

In practice, the simple formula is computed first and the result averaged with the temperature. If this heat index value is 80 degrees F or higher, the full regression equation along with any adjustment as described above is applied.

The Rothfusz regression is not valid for extreme temperature and relative humidity conditions beyond the range of data considered by Steadman.

Development and Training

- WPC HydroMet Testbed
- Development
- Experimental Products

WPC Overview

- About the WPC
- Mission and Vision
- Staff
- WPC History
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Meteorological Calculators

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Exhibit 6

NATIONAL WEATHER SERVICE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

WRN

NWS Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution   Extreme Caution   Danger   Extreme Danger

The Heat Index is a measure of how hot it really feels when relative humidity is factored in with the actual air temperature. To find the Heat Index temperature, look at the Heat Index Chart above or check our Heat Index Calculator. As an example, if the air temperature is 96°F and the relative humidity is 65%, the heat index--how hot it feels--is 121°F. The red area without numbers indicates extreme danger.

The National Weather Service will initiate alert procedures when the Heat Index is expected to exceed 105°-110°F (depending on local climate) for at least 2 consecutive days.

NWS also offers a Heat Index chart for area with high heat but low relative humidity. Since heat index values were devised for shady, light wind conditions, **exposure to full sunshine can increase heat index values by up to 15°F.** Also, **strong winds**, particularly with very hot, dry air, can be extremely hazardous.

Heat Safety Resources

Heat Safety
Maximum Heat Index Forecast
Children, Pets and Vehicles
Heat Awareness Campaign
Ultraviolet (UV) Safety
Games and Activities for Kids
Education and Outreach
Links, Partners

Exhibit 7

	TEXAS DEPARTMENT	**NUMBER:**	**AD-10.64 (rev. 7)**
	OF	**DATE:**	**March 17, 2015**
	CRIMINAL JUSTICE	**PAGE:**	**1 of 13**
		SUPERSEDES:	**AD-10.64 (rev. 6) November 10, 2008**

ADMINISTRATIVE DIRECTIVE

SUBJECT: **EXTREME TEMPERATURE CONDITIONS IN THE TDCJ**

AUTHORITY: Tex. Gov't Code § 493.006

Reference: American Correctional Association Standard: 4-4153; TDCJ *Risk Management Program Manual*, *Correctional Managed Health Care (CMHC) Policy Manual* D-27.2, "Heat Stress"

APPLICABILITY: Texas Department of Criminal Justice (TDCJ)

POLICY:

The TDCJ shall establish guidelines to assist unit administration in adapting offender housing areas and work assignments to temperatures that cannot be controlled by the TDCJ. Guidelines for outside recreation are found in the *Recreation Program Procedures Manual*.

Every reasonable effort shall be made to prevent injuries related to extreme temperatures in the TDCJ. The decision to expose offenders to extreme temperatures, either cold or heat, shall be made by the appropriate on-site staff in order to address the conditions specific to the area in which the facility is located. TDCJ offenders may be required to work in conditions of extreme cold or heat when situations occur requiring specific work be completed regardless of the temperature or weather conditions.

The TDCJ shall work closely with medical staff to immediately identify offenders at risk from extreme temperatures. Incidents related to extreme temperatures shall be reported to TDCJ administration.

DEFINITIONS:

"Wellness Check" is when a correctional officer performing routine security rounds goes to an offender's cell or bunk to visualize the offender for wellness due to the offender previously being identified as having a condition or being on a medication that makes the offender more susceptible to temperature-related issues.

<u>PROCEDURES:</u>

Prior to exposing offenders to extreme temperature conditions, the warden and applicable departmental supervisors shall ensure appropriate measures are taken to prevent extreme temperature-related injuries, including consulting medical staff to identify specific hazards. In all cases of temperature-related incidents or injuries, unit medical staff and the unit risk manager shall be notified immediately. Medical staff shall remove the distressed offender from the environment by the most expeditious means available to receive proper medical treatment.

I. Monitoring Procedures

Procedures and exposure charts, Wind Chill Index (Attachment A), and Heat and Humidity Matrix (Attachment B), are provided to assist unit administration in determining safe working conditions in extreme temperature conditions.

A. During work assignments, offenders shall be exposed to no more than four hours of extreme temperature conditions at a time, until acclimated to existing weather conditions. Work periods may then be extended as offenders physically acclimate to weather conditions. Appropriate clothing shall be worn to protect offenders from extreme temperature conditions at all times.

B. Unit staff shall monitor the temperature once every hour between 12:30 a.m. and 11:30 p.m. The temperature shall be announced over the radio every hour between 6:30 a.m. and 6:30 p.m. and documented 24 hours a day on the Temperature Log (Attachment C). If conditions warrant, the warden may also request additional readings.

C. Temperature Log

1. The warden shall designate a central location to maintain the Temperature Log.

2. The Temperature Log shall indicate the wind chill or heat index.

3. Temperature information is available through the following:

a. The National Oceanic and Atmospheric Administration (NOAA) website (www.noaa.gov);

b. NOAA Weather Radio;

c. Local weather radio and television stations; or

d. Onsite weather instrumentation, if available.

4. Temperature Logs shall be maintained in accordance with the TDCJ *Records Retention Schedule*.

II. Extreme Cold Conditions

A. Determination

1. The warden shall use the Wind Chill Index (Attachment A), the local news and weather media, and weather conditions recorded by instruments located at the unit in determining the safety of cold weather working conditions.

2. Clothing considered appropriate for offenders working in cold weather includes: thermal underwear, insulated jackets, cotton or leather gloves, insulated hoods, work shoes, and socks. The Wind Chill Index shall be used to determine the need for insulated hoods and leather gloves. Appropriate clothing shall be issued even when the Wind Chill Index indicates little danger of exposure injury.

3. If guidance is needed, medical staff shall be consulted to assist in determining appropriate clothing and footwear needed to prevent cold injury.

4. Care shall be taken to prevent perspiration, which could soak clothing and thus compromise the insulating value of the clothing.

5. Layers of clothing shall be removed or added according to the temperature and level of physical activity.

B. Symptoms

1. Hypothermia is a condition occurring when the body loses heat faster than it can produce heat. With the onset of this condition, blood vessels in the skin tighten in an attempt to conserve vital internal body heat, affecting the hands and feet first.

2. If the body continues to lose heat, involuntary shivers begin. This reaction is the way the body produces more heat and is usually the first real warning sign of hypothermia.

3. Further heat loss produces speech difficulty, forgetfulness, loss of manual dexterity, collapse, and possibly death.

C. Types of Hypothermia

Hypothermics are divided into the following three categories, depending on the degree of injury.

1. Category One

Injured individuals are conscious, but cold, with a rectal temperature above 90 degrees Fahrenheit (ºF). These individuals shall be handled carefully, insulated from further heat loss, and transported to the unit Medical Department for additional care.

2. Category Two

Injured individuals are unconscious and with a rectal temperature of 90ºF or below. These individuals shall be handled carefully, insulated from further heat loss, and transported to the unit Medical Department for additional care.

3. Category Three

Injured individuals are comatose with no palpable pulse and no visible respiration. Although these individuals appear to be deceased, there may be a slight chance of recovery if the rectal temperature is 60.8ºF or higher. If indicated, medical staff shall proceed with life-saving measures.

If medical staff is unavailable, correctional staff shall follow the procedures outlined in Section V.B. of this directive and contact emergency medical services.

III. Extreme Heat Conditions

A. Determination

1. Guidelines assisting the warden in making the determination that an extreme heat condition is occurring can be found in the Heat and Humidity Matrix (Attachment B). Weather conditions recorded by instruments at the unit, and reports by the local news media shall be used to confirm temperature and humidity conditions. When the temperature is over 85ºF, the warden shall use the Heat and Humidity Matrix to determine the heat index, which shall be used as an indicator of the risk for heat-related injury.

2. At any point when the Heat and Humidity Matrix indicates the possibility of heat exhaustion, the warden shall instruct the appropriate staff to immediately initiate the precautionary measures identified in the Heat and Humidity Matrix.

3. If guidance is needed, medical staff shall be consulted prior to exposing offenders to extremely hot working conditions to evaluate the hazards of the current temperatures and humidity, including indoor work areas, such as a boiler room. The hazard of sunburn and other results of ultraviolet (UV) radiation shall also be closely monitored.

4. Offenders shall be provided and required to wear clothing appropriate for the temperatures and hazards imposed by UV radiation. For example, light-colored hats can be used to an advantage in high heat and direct sunlight.

5. Drinking water and cups shall always be available to offenders in conditions of hot weather. High water intake, according to the Heat and Humidity Matrix, shall be encouraged. According to individual medical advice, liquids containing sodium may be used depending on an offender's state of acclimatization to hot weather conditions. Offenders newly-assigned to jobs that require strenuous work under conditions with an apparent air temperature of 90º F or greater must be acclimatized before assuming a full workload. These offenders shall work no more than four hours at a time, separated by at least one hour of rest in a cooler environment, for the first week. After the first week, offenders newly-assigned to jobs may assume a normal work schedule. Acclimatization can be lost in as little as two weeks; therefore, if offenders are away from a hot work environment for more than two weeks, they shall be reacclimatized. Acclimatization is not necessary for individuals assigned to the same job when temperatures vary with seasonal change. Offenders and staff working at apparent air temperatures over 90º F shall be provided access to and encouraged to consume water prior to their work assignment and as needed during the workday.

6. As offenders arrive on intake facilities, a staff member from the medical department shall conduct an initial screening to determine if the offender has any conditions or is on any medication that would make the offender more susceptible to heat. If medical staff determines an offender has a condition or is on a medication that would make the offender more susceptible to heat, correctional staff shall be instructed to perform wellness checks on the offender until a full medical evaluation may be conducted.

7. Offenders under treatment with diuretics or medications that inhibit sweating require special medical evaluation prior to being assigned to work in extreme heat. These offenders shall receive wellness checks in offender housing areas when the Heat and Humidity Matrix indicates the possibility of heatstroke, heat cramps, or heat exhaustion.

B. Symptoms

1. Heatstroke symptoms include:

   a. Diminished or absent perspiration (sweating);

   b. Hot, dry, and flushed skin; and

   c. Increased body temperatures, which if uncontrolled may lead to delirium, convulsions, seizures, and possibly death. Medical care is urgently needed.

2. Heat cramp symptoms include:

   a. Painful, intermittent, and involuntary muscle spasms following hard physical work in a hot environment; and

   b. Cramps usually occurring after heavy perspiring, and often beginning at the completion of hard physical work.

3. Heat exhaustion symptoms include:

   a. Profuse perspiration, weakness, rapid pulse, dizziness, and headaches;

   b. Cool skin, sometimes pale and clammy, with perspiration;

   c. Normal or subnormal body temperature; and

   d. Possible nausea, vomiting, and unconsciousness.

IV. Preventive Care and Precautions

A. Offenders incarcerated within the TDCJ shall be assessed for medical and mental impairments by qualified healthcare personnel who will assign each offender appropriate restrictions related to physical activities, transportation, and work. Appropriate limitations and restrictions shall be assigned and entered on the Health Summary for Classification (HSM-18). Restrictions may indicate:

1. No Work in Direct Sunlight – This applies to individuals taking certain medications or who have conditions that are significantly aggravated by exposure to direct sunlight for which sunscreen, protective clothing, or equipment is inadequate. Refer to CMHC policy D-27.3, "Photosensitivity."

2. No Temperature Extremes – This applies to individuals prescribed certain heat-sensitive medications or those who have a condition causing them to be sensitive to extreme temperatures, such as Reynaud's Phenomenon, or a history of heatstroke. Heat index and chill factor shall be taken into account when considering extreme temperatures. Refer to CMHC policy D-27.2, "Heat Stress" for a list of heat-sensitive medications.

B. TDCJ and medical staff shall work together to identify offenders susceptible to temperature-related illness due to medical conditions. Medical staff shall provide correctional staff a list of offenders susceptible to temperature-related illness due to medical conditions, including offenders on prescribed diuretics or other medications known to inhibit the dissipation of heat.

C. Representatives from various divisions shall meet annually to review best practices concerning preventive care and precautions with extreme temperatures. A mainframe message shall be sent from the Correctional Institutions Division (CID) director to inform unit wardens of these best practices in order to provide guidance in the prevention of heat-related injuries and illness.

D. Training will be conducted at units as outlined in Section VI.

E. In situations where the heat index is over 90º F, units will initiate the following steps:

1. Provide additional water and cups in offender dorms and housing areas and during meal times, along with ice, if possible;

2. Transport psychiatric inpatient offenders to other facilities via air-conditioned transfer vehicles only;

3. Transport offenders during the coolest hours of the day, when possible;

4. Allow offenders to wear shorts in dayrooms and recreational areas;

5. Ensure maintenance of fans, blowers, and showers in offender housing areas;

6 Ensure all employees currently have, or are provided with, Treatment and Prevention of Heat/Cold Illness Pocket Cards, obtained through the Prison Store and available at the units, and that the cards are carried on their person while at the unit;

7. Allow additional showers for offenders when possible. Lower the water temperature for single temperature showers in offender housing areas;

8. Place posters in housing areas reminding offenders of heat precautions and the importance of water intake; and

9. Allow fans for offenders in all custody levels, to include administrative segregation and disciplinary status. Ensure fan program is in place allowing the permanent issue of fans to indigent offenders. Fans shall only be confiscated if altered or stolen.

V. Emergency Treatment

A. In all cases of temperature-related incidents or injuries:

1. The first aid process shall be initiated immediately by correctional or other unit staff.

2. Medical staff and the unit risk manager shall be notified immediately. If there is no on-site medical staff, 911 shall be called immediately.

3. Any temperature-related incident or injury shall be reported to the Emergency Action Center in accordance with AD-02.15, "Operations of the Emergency Action Center and Reporting Procedures for Serious or Unusual Incidents."

B. If an injury is sustained in extreme cold conditions, staff shall:

1. Bring the distressed offender out of the cold and restrict any further duties or activities until the severity of the injury is evaluated.

2. Remove any wet clothing and insulate the offender with dry, warm blankets or clothing, ensuring all constricting items of clothing and footwear are removed from injured areas and the injured areas are covered.

3. If frostbite exists, gently heat the affected area with warm water or towels, a heating pad, or hot water bottles. Do not rub the affected area or rupture blisters.

4. If a lower extremity is affected, treat by slightly elevating the affected area.

5. If the offender is conscious, encourage consumption of warm, sweetened liquids.

6. If necessary, initiate the "CAB" of life support - restore Circulation, open Airway, and assist Breathing.

7. If evacuation from cold requires travel on foot, do not thaw the affected area until the offender reaches medical help.

8. Transport the offender to medical care as soon as possible and continue treatment after arriving at the site or when the offender is delivered to medical staff's care.

C. If an injury is sustained in extreme heat conditions, staff shall:

1. Immediately begin an attempt to decrease the offender's temperature by placing the offender in a cool area.

2. Only force oral fluid intake if the offender is conscious and able to safely swallow.

3. Remove heavy clothing or excess layers of clothing; saturate remaining lightweight clothing with water. Position the offender in the shade, allowing air movement past the offender, and if necessary, fan the offender to create air movement.

4. If ice is available, place ice packs in armpit and groin areas.

5. Take all of these measures while moving the offender in the most expeditious means available to continue with and obtain proper medical treatment.

6. Ensure, whenever medical staff are on-site, treatment is continued as directed by the physician or medical staff.

VI. Training

A. Each warden shall ensure training in the prevention of injuries due to extreme temperatures is provided by unit medical staff to all supervisors designated by the warden. Training concerning cold extremes shall be completed in September, and training concerning heat extremes shall be completed in May of each year.

1. Supervisors shall be responsible for training employees and work assigned offenders.

2. Non-work assigned offenders shall be notified of cold and heat awareness via the dayroom bulletin boards and other common use areas, or through publications such as *The Echo* or the TDCJ *Offender Orientation Handbook*.

B. Training shall be documented as outlined in the TDCJ *Risk Management Program Manual*. Documentation of completed training shall be maintained by the facility health administrator. Copies of all rosters from staff training shall be provided to the human resources representative and unit risk manager. The unit risk manager shall forward a copy of the training roster to the respective regional risk manager.

The regional risk manager shall forward the total number of employees and offenders trained to the Risk Management Central Office.

C. A standardized training program shall be developed by the TDCJ in conjunction with the University of Texas Medical Branch Clinical Education Department. Each unit shall be provided a copy of the training program in the form of a DVD to facilitate the required training.

1. The initial extreme temperature conditions training is provided in Pre-Service Training sessions, and additional training shall be provided in annual In-Service Training sessions.

2. The training is given in a group setting, when possible.

3. All units are responsible for conducting an annual standardized training program using unit-based medical staff.

4. The facility health administrator for each unit shall submit documentation of heat and cold extreme training for TDCJ employees, medical staff, and offenders to the Health Services Division Office of Health Services Monitoring annually by June 1st.

VII. Notification to TDCJ Administration

A. Offender deaths during periods of extreme temperatures, when the cause of death is unknown, shall be treated as accidental deaths as defined in AD-02.15, "Operations of the Emergency Action Center and Reporting Procedures for Serious or Unusual Incidents," until ruled otherwise by a medical professional through an autopsy or subsequent evaluation. An administrative incident review is required for all offender deaths, except natural cause attended deaths, in accordance with AD-02.15, during a period of extreme temperatures until affirmatively reclassified as a natural cause attended death by a medical professional.

B. An annual review of all deaths occurring during periods of extreme temperatures shall be conducted during the last quarter of the calendar year by representatives from the CID, Administrative Review and Risk Management Division, Health Services Division, Executive Services, the Office of the General Counsel, and any other divisions, as appropriate for the incident.

Brad Livingston*
Executive Director

* Signature on file

WIND CHILL INDEX

Wind Speed in MPH	ACTUAL THERMOMETER READING (°F)									
	50	40	30	20	10	0	-10	-20	-30	-40
	EQUIVALENT TEMPERATURE (°F)									
CALM	50	40	30	20	10	0	-10	-20	-30	-40
5	48	37	27	16	6	-5	-15	-26	-36	-47
10	40	28	16	4	-9	-21	-33	-46	-58	-70
15	36	22	9	-5	-18	-36	-45	-58	-72	-85
20	32	18	4	-10	-25	-39	-53	-67	-82	-96
25	30	16	0	-15	-29	-44	-59	-74	-88	-104
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109
35	27	11	-4	-20	-35	-49	-67	-82	-98	-113
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116
Over 40 MPH (little added effect)	MINIMAL DANGER (for properly clothed person)				INCREASING DANGER (Danger from freezing or exposed flesh)			GREAT DANGER		

The human body senses "cold" as a result of both the air temperature and wind velocity. Exposed flesh cools rapidly as the wind velocity increases. Frostbite can occur at relatively mild temperatures if wind penetrates the body insulation. For example, when the actual air temperature of the wind is 40°F and its velocity is 30 mph (48 km/h), the exposed skin would perceive this situation as an equivalent still air temperature of 13°F.

Clothing considered appropriate and currently available in inventory is thermal underwear, insulated jackets, cotton and leather gloves, insulated hoods, work shoes, and socks. Again, caution shall be taken when exposure occurs for longer periods of time.

HEAT AND HUMIDITY MATRIX

	AIR TEMPERATURE (°F)										
	70	75	80	85	90	95	100	105	110	115	120
Relative Humidity	Apparent Temperature										
0%	64	69	73	78	83	87	*91	*95	*99	*103	**107
10%	65	70	75	80	85	*90	*95	*100	**105	**111	**116
20%	66	72	77	82	87	*93	*99	**105	**112	**120	***130
30%	67	73	78	84	*90	*96	*104	**113	**123	***135	***148
40%	68	74	79	86	*93	*101	**110	**123	***137	***151	
50%	69	75	81	88	*96	**107	**120	***135	***150		
60%	70	76	82	*90	*100	**114	***132	***149			
70%	70	77	85	*93	**106	**124	***144				
80%	71	78	86	*97	**113	***136					
90%	71	79	88	*102	**122						
100%	72	80	*91	**108							

* Heat exhaustion possible
** Heatstroke possible
*** Heatstroke imminent

Heat Exhaustion: Staff shall ensure adequacy of water intake, look for signs of exhaustion, and provide five minute rest breaks every hour.

Heatstroke Possible: Staff shall promote high water intake, provide five minute rest breaks every one-half hour, lying down with feet up, and reduce work by one-third.

Heatstroke Imminent: Staff shall secure outside work or reduce work pace by one-half to two-thirds, provide 10 minute rest breaks every one-half hour, lying down with feet up, and insist on increased water intake.

Heat and Humidity: At high temperatures, the human body normally cools itself through the evaporation of perspiration, but humidity interferes with this process. The above table, from the National Weather Service, shows how discomfort and health risks grow as heat and humidity increase. Remember: Apparent temperatures may run 15 to 30 degrees higher in urban areas with vast expanses of concrete and asphalt.

TEXAS DEPARTMENT OF CRIMINAL JUSTICE
Temperature Log

Unit: _______________

Date:	Outside Air Temperature	Humidity or Wind Speed	Heat Index or Wind Chill**	Person Recording
12:30 a.m.				
1:30 a.m.				
2:30 a.m.				
3:30 a.m.				
4:30 a.m.				
5:30 a.m.				
6:30 a.m.*				
7:30 a.m.*				
8:30 a.m.*				
9:30 a.m.*				
10:30 a.m.*				
11:30 a.m.*				
12:30 p.m.*				
1:30 p.m.*				
2:30 p.m.*				
3:30 p.m.*				
4:30 p.m.*				
5:30 p.m.*				
6:30 p.m.*				
7:30 p.m.				
8:30 p.m.				
9:30 p.m.				
10:30 p.m.				
11:30 p.m.				

* Temperatures and Wind Chill Index/Heat Index to be announced over the radio

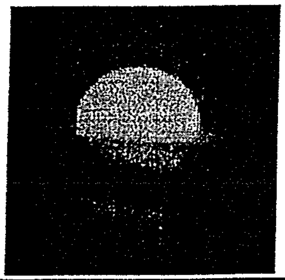
** Temperatures between 51 and 69 degrees Fahrenheit (ºF) are not represented on the Wind Chill Index (Attachment A) or the Heat and Humidity Matrix (Attachment B). Indicate (N/A) in these fields when applicable.

Exhibit 8

TDCJ Risk Management's

Training Circular

Volume 13 Issue 5 | Risk Management Issues | May 2013



May
Hot Weather

Summer time in Texas is symbolic of our state. From the dry desert heat of West **Texas**, to the muggy humid East Texas, one thing is for sure, it's **HOT**! Extreme heat in the workplace can pose serious health and safety issues.

Every reasonable effort should be made in the interest of preventing heat related injuries in the workplace. Problems of heat stress are more common than those prevented by very cold environments.

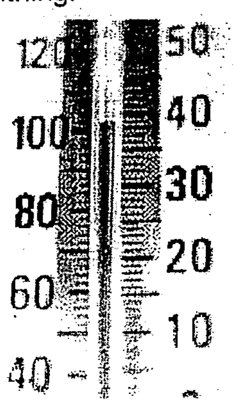
Heat stress is best prevented by acclimatizing staff and offenders to working under hot and humid climate conditions, assuring adequate fluid intake and, to a lesser extent, assuring adequate salt intake.

Proper treatment of heat stress should begin at the worksite, but severe heat stress is a medical emergency which must be treated in a medical facility.

EXTREME HEAT

Workers can suffer heat-related injuries, illnesses, and even death when the body's temperature control system is overloaded. Normally, the body cools itself by sweating, but under some conditions just sweating is not enough.

When a person's body temperature rises rapidly their vital organs are threatened. In a typical year about 175 Americans succumb to heat. Heat kills more people each year in the United States than tornadoes, floods, hurricanes, or lightning.



HEAT STRESS FACTORS

For the human body to maintain a constant internal temperature, the body must rid itself of excess heat. This is achieved primarily through varying the rate and amount of blood circulation to the outer layers of the skin and releasing of fluid onto the skin by the sweat glands.

The evaporation of sweat cools the skin, releasing large quantities of heat from the body. As area temperatures approach normal skin temperature, cooling of the body becomes more difficult.

If air temperature is as warm or warmer than the skin, blood brought to the body surface cannot lose its heat, and sweating becomes the primary means of maintaining a constant body temperature.

Sweating does not cool the body unless the moisture is removed from the skin by

evaporation. Under conditions of high humidity, the evaporation of sweat from the skin is decreased and the body's efforts to maintain acceptable body temperature may be significantly impaired

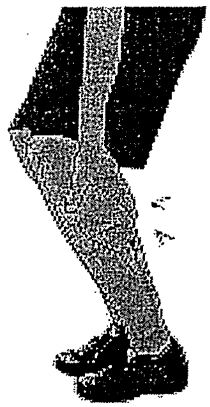
HEAT STRESS SAFETY HAZARDS

The frequency of accidents in general appears to be higher in hot environments than in more moderate temperatures. Heat tends to promote accidents that occur because of sweaty palms, dizziness, or the fogging of safety glasses. Employees can get burned from accidental contact with hot materials such as steam or metal surfaces.

Mental confusion, tiredness, and irritability may occur when an employee becomes overheated. The effect of these conditions can result in poor judgment and unsafe practices.

TYPES OF HEAT-REALTED ILLNESSES

Heat Cramps: usually develop following strenuous exercise, in muscles that have been subjected to extensive work. The pain is brief, intermittent and crampy, and may be quite severe. Heat cramps usually occur after several hours of work, and may occur even at low ambient temperatures. The cause is inadequate replacement of electrolytes (sodium and potassium).



Treatment consists of rest in a cool place and replacement of fluids and electrolytes, by drinking cool, caffeine-free fluids and eating a meal.

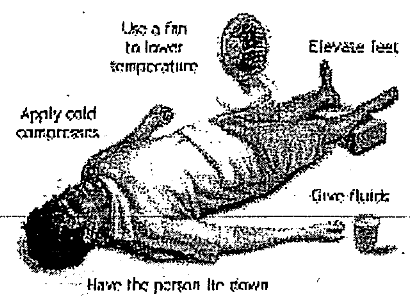
Prevention is accomplished by ample fluid intake during and after work, and salting of food during meals if not medically contraindicated. Use of electrolyte replacement drinks or lightly salted fruit drinks at the worksite may also be beneficial.

Heat Exhaustion (Heat Prostration): the most common form of heat stress, caused by depletion of water and salt.

Symptoms include weakness, anxiety, fatigue, thirst, dizziness, headache, nausea and urge to defecate. Signs include profuse perspiration, rapid pulse, in coordination and confusion.

Heat prostration may lead to **heat syncope**, a sudden onset of collapse that is usually of brief duration. During heat syncope the patient appears ashen gray and skin is cool and clammy. Failure to treat heat exhaustion may result in progression to heat stroke. Risk factors include failure to maintain adequate fluid intake during exertion, and taking diuretics.

Treatment is to remove the person to a cool area, having them lie down, remove shirt and shoes, begin oral rehydration. Some cases may require intravenous fluid replacement.



Prevention is accomplished by ample fluid intake during work, proper work-rest cycles, and salting of food during meals if not medically contraindicated.

Heat Stroke: is a medical emergency. While it may be preceded by signs of heat exhaustion, the onset is often

sudden. In heat stroke the body has lost its ability to dissipate heat and maintain a normal body temperature. Body temperature is often elevated over 106°F.

Exertional heat stroke occurs in young, healthy people who maintain inadequate fluid intake during exertion. Signs include headache, chills, gooseflesh, weakness, in coordination, nausea and vomiting, progressing to unconsciousness.

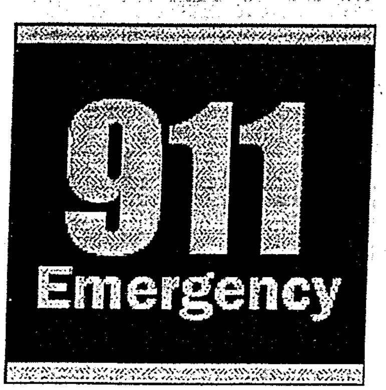
Classical heat stroke is seen in the elderly, those with predisposing medical conditions such as congestive heart failure, diabetes and alcoholism, and those on medications which cause fluid depletion, interfere with sweating or interfere with the body's thermoregulatory system.

Classical heat stroke has few premonitory signs. Collapse may be among the first symptoms. Skin is hot and dry, and pulse is rapid and weak. Shock and death may occur in either type of heat stroke.

Treatment is a medical emergency. The patient must be removed to a cool, air-conditioned place, stripped and cooled rapidly using a water spray and cooling fans.

Prevention includes ample fluid intake during work, proper work-rest cycles, excluding people at high risk from working under conditions of extreme heat and humidity, and maintaining adequate indoor conditions, such as access to cool fluids and use of cooling fans, for persons at increased risk for heat stroke.

The key to all heat related illness is PREVENTION.



HEAT RASH

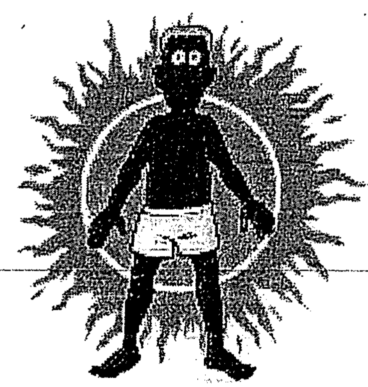
Heat Rash - Heat rash is a skin irritation caused by excessive sweating during hot, humid weather. It can occur at any age but is most common in young children.

Recognizing Heat Rash - Heat rash looks like a red cluster of pimples or small blisters. It is more likely to occur on the neck and upper chest, in the groin, under the breasts, and in elbow creases.

What to Do - The best treatment for heat rash is to provide a cooler, less humid environment. Keep the affected area dry. Dusting powder may be used to increase comfort. Treating heat rash is simple and usually does not require medical assistance. Other heat-related problems can be much more severe.

SUN SAFETY

People who spend a lot of time outdoors run the risk of suffering from more than just heat exhaustion or heat stress.



Repeated exposure to ultraviolet (UV) radiation places them at risk for various forms of skin cancer and eye diseases, such as cataracts. The number of skin cancer cases in the United States continues to increase each year.

The sun's rays are most in-

tense and damaging during the summer months. The greatest exposure occurs from 10:00 a.m. until 4:00 p.m., but you can still get a sunburn during cloudy weather, other seasons, and other times of the day.

The areas of the body most at risk to exposure to UV radiation are the back of the neck, ears, face, eyes, and arms.

These and other body parts can be easily protected by wearing proper clothing, sunglasses, and sunscreen. You can reduce your risk by taking precautions and avoiding repeated exposure to the sun.

AD-10.64

Fortunately, the Agency recognizes the very real hazards associated with working within such temperature extremes and has taken proactive measures to protect staff.

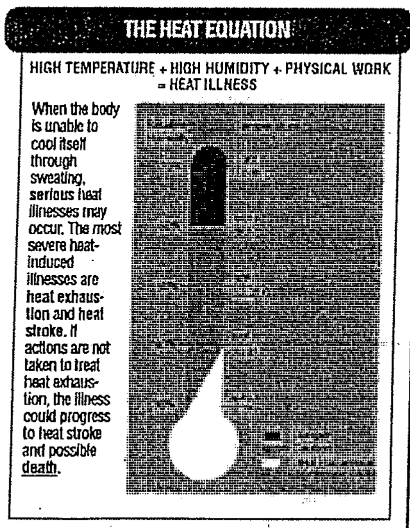
So much in fact, that this medical issue has an Administrative Directive devoted to it. AD-10.64 is the Agency's policy addressing temperature extremes in the TDCJ workplace.

The last page of AD-10.64 contains the Heat and Humidity Matrix, as well as preventive steps to take when the apparent or 'feels like' temperature reaches varying levels of severity.

According to the matrix, which is adopted from the National Weather Service, a person can begin to feel the effects of heat exhaustion in temperatures as low as 80°.

Risks for heatstroke begin at temperatures of 91°. At 95°, there can be an imminent danger of developing heatstroke.

Bear in mind, these risk factors are accompanied by extremely high humidity levels.



REFERENCES:

- TDI, DWC, Workplace Safety, HS99-151B
- CMHC, Heat Stress, B-15.2
- TDI, DWC, Heat-Related Injury & Illness Prevention Factsheet, HS04-047B
- TDI, DWC, Sun Safety, HS96-096E
- CDC, Emergency Preparedness & Response, Extreme Heat
- TDCJ, AD-10.64, Temperature Extremes in the TDCJ. Workplace

Training Circular
TDCJ Risk Management Department
Volume 13 Issue 5
May 2013

Oscar Mendoza
Director, Administrative Review and Risk Management

Robert C. Warren
Risk Management Specialist V
Risk Management

The *Training Circular*, a publication of the Texas Department of Criminal Justice Risk Management Department, is published monthly in an effort to promote and enhance risk management awareness on issues relating to TDCJ employees. Design and layout of the Training Circular is performed by Robert C. Warren, Risk Management. Comments, suggestions and safety related items are welcome. Send Suggestions to:

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Risk Management Department
1060 Hwy 190 East
Huntsville, Texas 77340
or,
robert.c.warren@tdcj.state.tx.us

Exhibit 9

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF TEXAS
HOUSTON DIVISION

KEITH COLE, JACKIE BRANNUM, RICHARD KING, DEAN ANTHONY, MOJICA, RAY WILSON, FRED WALLACE, AND MARVIN RAY YATES, individually and on behalf of those similarly situated,	)	CIVIL ACTION NO. 4:14-cv-1698
Plaintiffs,	)	
v.	)	
BRAD LIVINGSTON, in his official capacity, ROBERTO HERRERA, in his official capacity, and TEXAS DEPARTMENT OF CRIMINAL JUSTICE,	)	
Defendants.	)	

****

ORAL DEPOSITION OF

DEBRA ALLISON

August 6, 2015

Volume 1

****

ORAL DEPOSITION OF DEBRA ALLISON, produced as a witness at the instance of the Plaintiffs, and duly sworn, was taken in the above-styled and numbered cause on the 6th day of August, 2015, from 10:07 a.m. to 7:01 p.m., before Abigail Guerra, CSR, in and for the State of Texas, reported by machine shorthand, at the Wallace Pack Unit, 2400 Wallace Pack Road, Navasota, Texas, pursuant to the Federal Rules of Civil Procedure and the provisions stated on the record or attached hereto.

A P P E A R A N C E S

FOR THE PLAINTIFFS:
KEITH COLE, JACKIE BRANNUM, RICHARD KING, DEAN ANTHONY, MOJICA, RAY WILSON, FRED WALLACE, AND MARVIN RAY YATES, individually and on behalf of those similarly situated,

Mr. Jeff Edwards
EDWARDS LAW
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Austin, Texas 78702
Phone: (512) 623-7727

FOR THE WITNESS AND DEFENDANT:
DEBRA ALLISON AND TEXAS DEPARTMENT OF CRIMINAL JUSTICE

Ms. Cynthia L. Burton
Mr. Daniel Neuhoff
OFFICE OF ATTORNEY GENERAL
300 West 15th Street
7th Floor
Austin, Texas 78701
Phone: (512) 463-8020

ALSO PRESENT:
Mr. Cody Ginsel, TDCJ Director
Ms. Jennifer L. Daniel

INDEX

EXHIBITS

EXHIBITS (cont'd)

medical conditions, such as, congestive heart failure, diabetes and, alcoholism, and those one medications which cause fluid depletion interfere with sweating or interfere with the body's thermoregulatory system." That's train your provide your officers?

A. Yes.

Q. Any reason to dispute that?

A. No.

Q. Okay. "Classical heatstroke has few premonitory signs." Something you train your officers about?

A. Yes.

Q. Okay. That means that when you come upon someone with a heatstroke, you've got to them medical intervention immediately, right?

A. Yes.

Q. Okay.

"Shock and death may occur in either type of heatstroke." That's something you train your officers about, right?

A. Where are we?

Q. It's the last sentence in that one, two -- fourth paragraph.

A. Yes.

Q. "Shock and death may occur in either type of heatstroke," right?

A. Yes.

Q. You wouldn't knowingly train your officers about something incorrect, would you?

A. No.

Q. If you became aware of an incorrect statement that you were providing training on -- you would -- TDCJ would change that, right?

A. If I had proven knowledge that it was an incorrect statement, I would seek out the person that wrote this, and I would let them with my proven reason why.

Q. And you would change it, right? You would not continue --

A. I would not change it. I would tell the person, and let them decide what they need to do with the information.

Q. You wouldn't expect -- you wouldn't expect TDCJ -- the highest levels of TDCJ the continually train people about things that are incorrect, would you?

A. I would not.

Q. Okay. Now, it goes on here with regard to your training circular, "Risks for heatstroke begin at temperatures of 91 degrees."

Is that a true statement that you train your officers about?

A. That is what we train, yes.

Q. Okay. Then it says, "At 95 degrees, there can been

an imminent danger of developing heatstroke."

Do you see that?

A. Can be, yes.

Q. Okay. So -- just so I'm clear, the Texas Department of Criminal Justice trains all officers at the Pack Unit, and elsewhere for that matter, that at 95 degrees there can be an imminent danger of developing heatstroke, correct?

A. Yes.

Q. You would expect every officer in the Texas Department of Criminal Justice at the Pack Unit to know that, correct?

A. They have been given that information. Whether they remember it or not, I have no knowledge of it.

Q. Sure.

You'd expect every Texas Department Criminal Justice employee to be familiar with the statement, "At 95 degrees, there can be an imminent danger of developing heatstroke," because it is provided to everyone in their training, correct?

A. It is provide to them, yes.

Q. So they should all be familiar with it, correct?

A. I can't tell you if they'll remember that statement.

Q. Whether they do remember it or don't, they all should remember it, right?

A. They've been provided it with that statement, yes.

A. The 25th is attached here.
Q. (BY MR. EDWARDS) On the 25th. Exactly.
A. Okay.
Q. Yes. That's what I meant.
MS. BURTON: And the first two pages...
MR. EDWARDS: I think, why don't we rip that third page off and make it 14A.
MS. BURTON: Right.
MR. EDWARDS: And that is also an incomplete, but let's at least not confused ourselves more than we have to.
(Exhibit 14A marked.)
Q. (BY MR. EDWARDS) Okay. So then we have 41.
Okay. Let's look at the 31st.
A. Yes.
Q. Did I hand you that?
A. Yes.
Q. Is that Exhibit 15?
Looks like from 11:30 a.m., it's 99-degree heat index, and it doesn't get under 99 until 9:30 p.m.; is that your understanding as well?
A. Somewhere between 8:30 and 9:30.
Q. Somewhere between 8:30 and 9:30.
So that's, boy, an hour-and-a-half -- that's more than ten hours above 99-degrees heat index, right?
A. Yes.

Q. Okay. Now, those documents show kind of throughout the summer that there are many days with temperatures above 90-degrees heat index, correct?

A. Yes.

Q. Okay. All right. So with regard to the indoor temperature logs -- well, you don't have knowledge of all of it, but you're pretty sure the recordings were done with that infrared device, correct?

A. Yes.

Q. Do you know where Mr. Levy or Mr. Cantú would have pointed that infrared device in taking measurements in the housing areas?

A. I know Mr. Levy had very specific areas that he did point that at. I do not know exactly what they are.

Like, for instance, he had a particular bunk. It was -- the blanket he would take that reading up. I do not what numbered bunk that is.

Q. Okay. That would be something Mr. Levy could tell us in theory, correct?

A. And maybe on his documentation.

Q. Perhaps.

Do you think it was a good idea to take internal temperature recordings?

A. No.

Q. Why not?

A. Because the device being used is an infrared, and it only takes the temperature of the object at which it is pointed.
Q. That's an easy problem to solve, though, right?
A. (No response.)
Q. You're aware that there are accurate temperature recording devices, right?
A. I can't just bring something in.
Q. Well, TDCJ sure as heck can just bring something in, right, that's accurate?
A. If TDCJ felt the need to, they would.
Q. So does that mean they didn't feel the need to?
A. I do not know.
Q. What's the point of taking inaccurate temperatures?
A. As I've already stated, Warden wanted to make sure that the devices that we have to help cool the temperature were working properly.
Q. Okay. Well, the temperature -- taking the temperature doesn't assist you in that regard in any way, correct?
MS. BURTON: Objection. Argumentative.
Q. (BY MR. EDWARDS) You can answer.
MS. BURTON: And it's way outside what you guys asked her to talk about.
MR. EDWARDS: Temperature recordings?

Q. (BY MR. EDWARDS) if I asked you a question, you wouldn't know, and, frankly, it would be inappropriate for me to ask. That's what you're telling me, fair.

A. Yes, I do not know.

Q. Okay. Do you know of any reason why -- well, I'll represent to you that monitors were placed and recorded temperatures. You didn't personally play any role in that, correct?

A. Correct.

Q. Okay. Do you know of any reason why they're not still recording temperatures at the unit?

A. No.

Q. Has there been any discussions about resuming the internal temperature recordings at the Pack Unit?

A. By means of infrared?

Q. By means of any device.

A. Do I know if there's any type of resuming?

Q. Well, are you personally aware of any discussions at any of the meetings that you have at risk management or throughout the Pack Unit of resuming taking internal temperature recordings?

A. No.

Q. The best of you -- is there still an alternate risk management officer?

A. Yes.

Q. His job is not to -- not to test the internal temperature recordings and note them for the record, correct?
A. He does not take indoor temperature readings, no.
Q. Okay. Does he check the ventilation system?
A. Yes.
Q. Do you document that?
A. Yes.
Q. So there are document checks every day of the ventilation systems?
A. There are inspection logs called the 8084, where each officer assigned to each position does an inspection every day. If there's a problem with it, it is recorded on there. Mr. Gradel, when he gets those reports, he then goes down the hallway, and he monitors to see what it is and what is not working.
Q. Is Mr. Gradel the new alternate --
A. Yes.
Q. -- risk manager?
A. Yes.
Q. What did Mr. Cantú become?
A. He's on shift.
Q. Is that a lateral position? A promotion? A demotion?
A. Lateral.
Q. Okay. Do you know why he stopped being the alternate

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF TEXAS
HOUSTON DIVISION

KEITH COLE, JACKIE BRANNUM, RICHARD KING, DEAN ANTHONY, MOJICA, RAY WILSON, FRED WALLACE, AND MARVIN RAY YATES, individually and on behalf of those similarly situated, Plaintiffs,	CIVIL ACTION NO. 4:14-cv-1698
v.	
BRAD LIVINGSTON, in his official capacity, ROBERTO HERRERA, in his official capacity, and TEXAS DEPARTMENT OF CRIMINAL JUSTICE, Defendants.	

* *

REPORTER'S CERTIFICATION
DEPOSITION OF DEBRA ALLISON
August 6, 2015
VOLUME 1

* *

I, ABIGAIL L. GUERRA, Certified Shorthand Reporter, in and for the State of Texas, hereby certify to the following:

That the witness, DEBRA ALLISON, was duly sworn by the officer and that the transcript of the oral deposition is a true record of the testimony given by the witness;

I further certify that pursuant to Federal Rules of

FOR THE PLAINTIFFS:
KEITH COLE, JACKIE BRANNUM, RICHARD KING, DEAN ANTHONY, MOJICA, RAY WILSON, FRED WALLACE, AND MARVIN RAY YATES, individually and on behalf of those similarly situated,

Mr. Jeff Edwards
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TEXAS DEPARTMENT OF CRIMINAL JUSTICE

Ms. Cynthia L. Burton
OFFICE OF ATTORNEY GENERAL
300 West 15th Street
7th Floor
Austin, Texas 78701
Phone: (512) 463-2080

I further certify that I am neither attorney, nor counsel for, nor related to, nor employed by any of the parties or attorneys to the action in which this deposition was taken;

Further, I am not a relative, nor an employee of any attorney of record in this cause, nor am I financially or otherwise interested in the outcome of the action.

Certified to by me this 18th day of August, 2015.

ABIGAIL GUERRA, Texas CSR 9059
Expiration Date: 12/31/15
WRIGHT WATSON & ASSOCIATES
Firm Registration No. 225
Expiration Date: 12-31-15
1250 S. Capital of Texas Highway
Building 3, Suite 400
Austin, Texas 78746
512-474-4363/512-474-8802 (fax)
www.wrightwatson.com

Job No. 150806AG

Exhibit 10

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF TEXAS
HOUSTON DIVISION

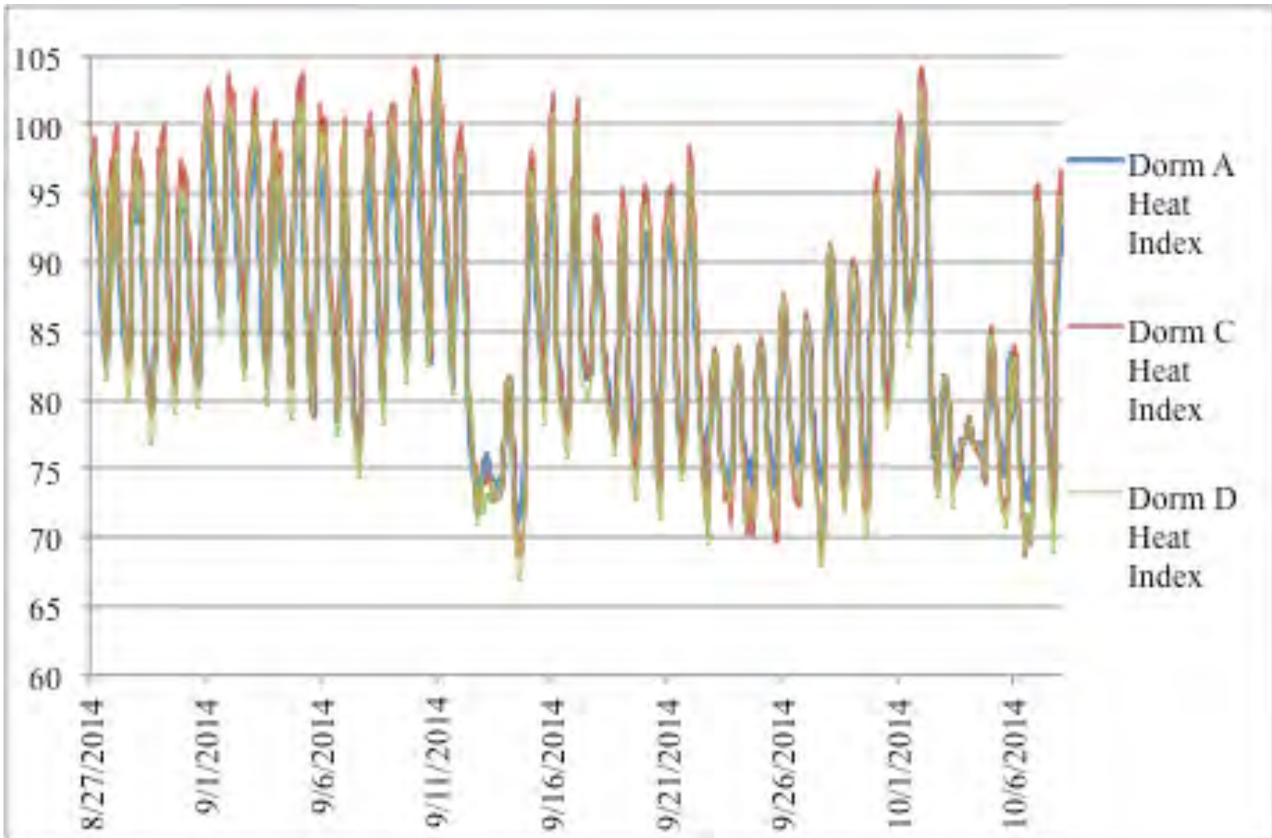
KEITH COLE, JACKIE BRANNUM, RICHARD KING, DEAN ANTHONY MOJICA, FRED WALLACE, RAY WILSON, and MARVIN RAY YATES, individually and on behalf of those similarly situated,	§ § § § § §	CIVIL ACTION NO. 4:14-cv-1698
Plaintiffs,	§ §	
v.	§ §	
BRAD LIVINGSTON, in his official capacity, ROBERTO HERRERA, in his official capacity, and TEXAS DEPARTMENT OF CRIMINAL JUSTICE,	§ § § § §	
Defendants.	§	

DECLARATION BY THOMAS SAGER

I, Thomas Sager, have been retained by the firm Edwards Law. I have reviewed my report and the attached Exhibits A-D in making this declaration, as well as a spreadsheet document. Please consider this declaration a supplement to my report in this matter.

A. Compilation of Measured Heat Index

The following chart and the larger version of the same chart contained in the attachment as Exhibit A are compilations of the heat index entries that I computed and appended to my original report (which had similar graphs, but separated the Dorms into different figures). As explained in my original report, the heat index was determined from the data provided by Plaintiffs' counsel which I understand was collected by the Texas Department of Criminal Justice at the Wallace Pack Unit inside inmate living areas. I also used the National Weather Service equation for the "heat index."



The data for the above chart, and the larger corresponding version in Exhibit A, show that apparent temperatures exceeded 90 degrees for a total of 301 hours in Dorm A; 359 hours in Dorm C; and 327 hours in Dorm D during fewer than 43 days (1016 hours) of measurements. On average, then, heat index was greater than 90 degrees 32 percent of the time.

The data for this chart further show that apparent temperatures exceeded 95 degrees for a total of 123 hours in Dorm A; 228 hours in Dorm C; and 176 hours in Dorm D during fewer than 43 days (1016 hours) of measurements. On average, then, heat index was greater than 95 degrees 17 percent of the time.

The data for this chart further show that apparent temperatures exceeded 100 degrees for a total of 5 hours in Dorm A; 71 hours in Dorm C; and 38 hours in Dorm D during fewer

than 43 days (1016 hours) of measurements. On average, then, heat index was greater than 100 degrees more than 3 percent of the time.

For the narrower period of August 27 to September 21, a period that lasted 612 hours, the data for this chart show that apparent temperatures exceeded 90 degrees for a total of 251 hours in Dorm A 296 hours in Dorm C; and 270 hours in Dorm D during fewer than 26 days (612 hours) of measurements. On average, then, heat index was greater than 90 degrees during 44 percent of the narrowed time period.

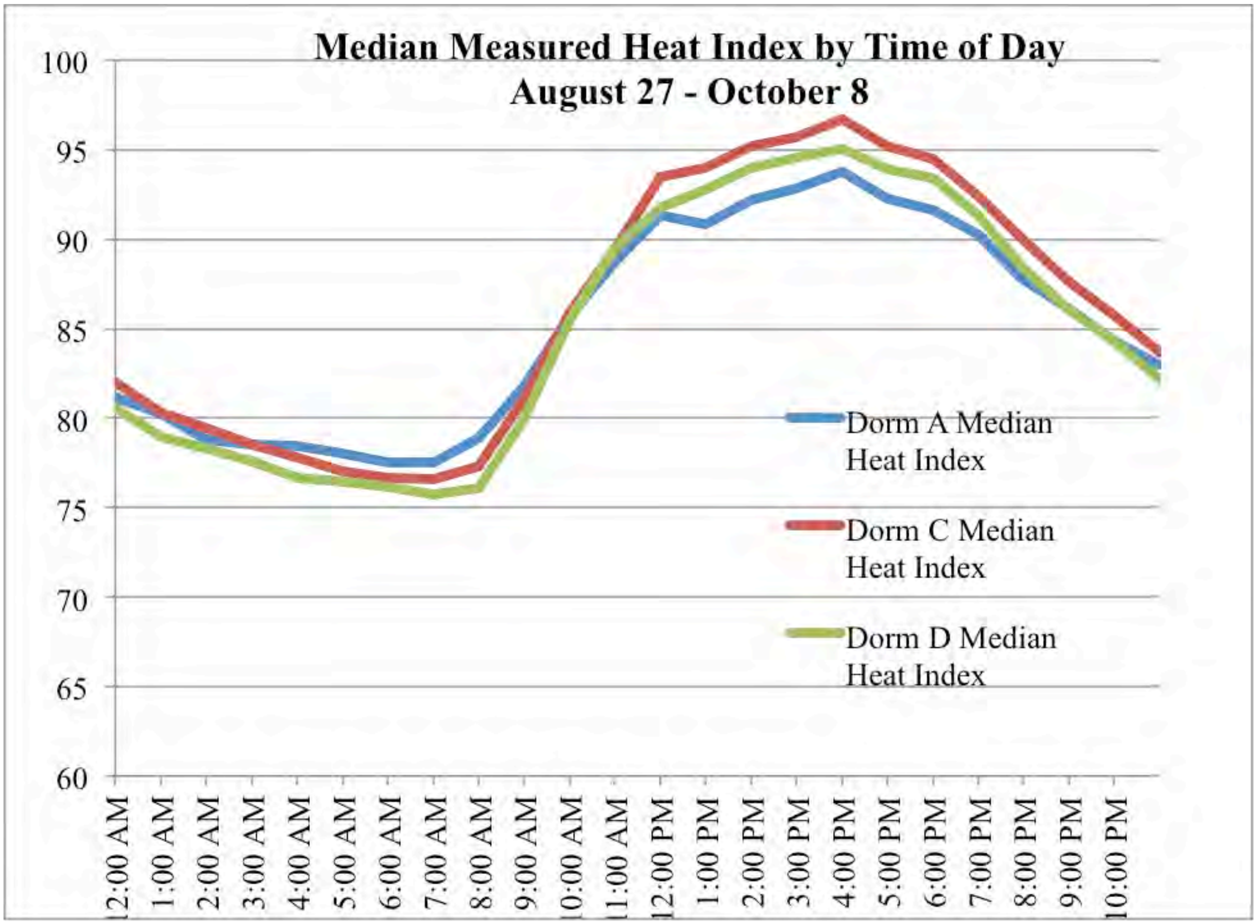
For the narrower period of August 27 to September 21, a period that lasted 612 hours, the data for this chart show that apparent temperatures exceeded 95 degrees for a total of 108 hours in Dorm A; 197 hours in Dorm C; and 155 hours in Dorm D during fewer than 26 days (612 hours) of measurements. On average, then, heat index was greater than 95 degrees during 25 percent of the narrowed time period.

For the narrower period of August 27 to September 21, a period that lasted 612 hours, the data for this chart show that apparent temperatures exceeded 100 degrees for a total of 5 hours in Dorm A; 62 hours in Dorm C; and 33 hours in Dorm D during fewer than 26 days (612 hours) of measurements. On average, then, heat index was greater than 100 degrees during 5 percent of the narrowed time period.

B. Median of Measured Heat Index by Time of Day

The data for the following chart and the larger, corresponding chart in Exhibit B show the median heat index during the period of measurement, August 27 to October 8, at each hour of the day. The "median" is the number halfway into a set of numbers, meaning that on half of the days measured, the heat index was at least as high as the median at the

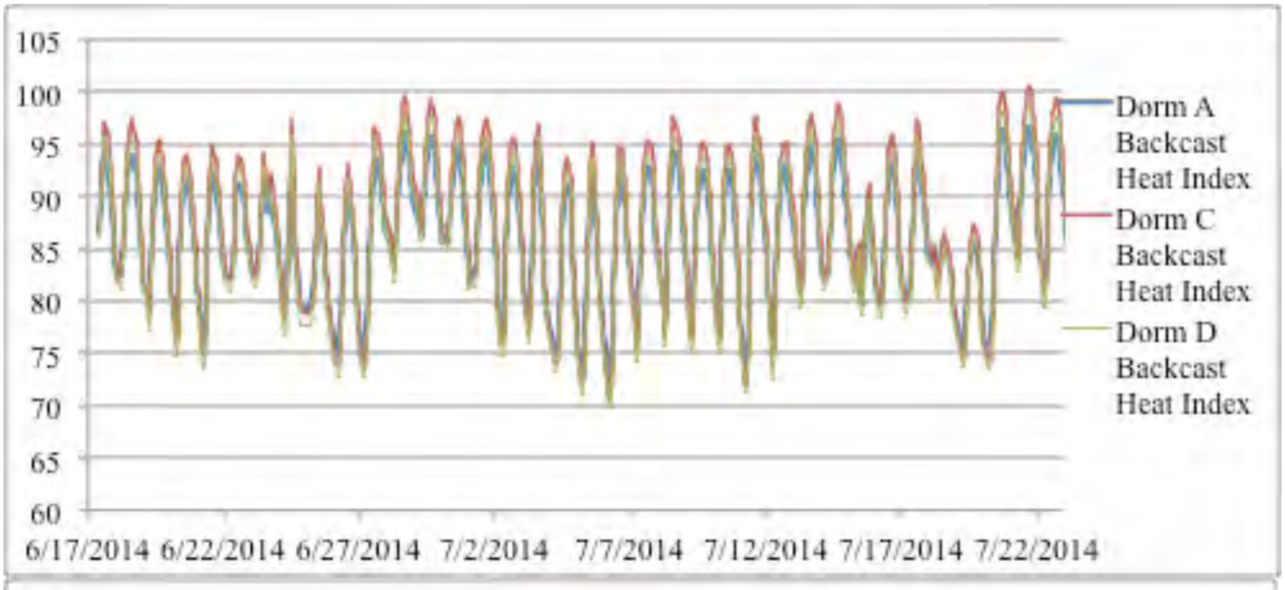
given hour, and on half of the days measured, the heat index was no higher than the median.

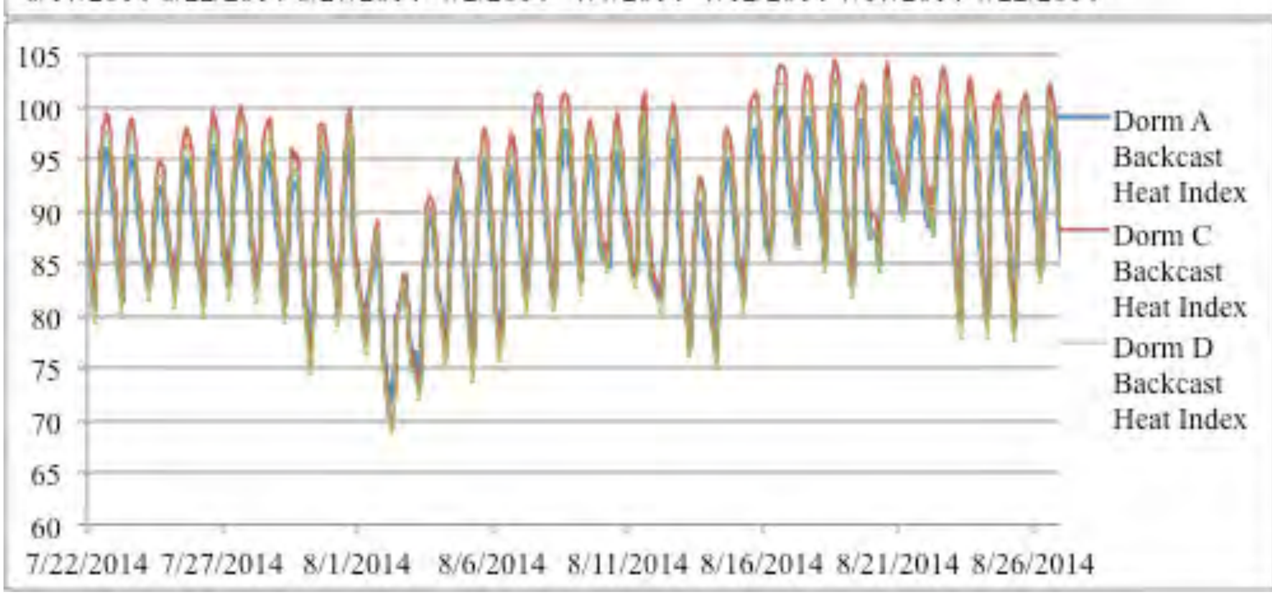


C. Compilation of Heat Index Values using my "Backcast" Model

As in part A, the following graphs and the larger, corresponding graphs in Exhibit C are compilations of the modeled or "backcasted"[1] heat index inside the Pack Unit. These numbers were created based upon the statistical comparison of the measured values to the Brenham Airport weather data as explained in my original report.

[1] The "backcast" method of estimation is Method 1 in my original report. Method 1 estimates the heat index directly; Method 2 estimates temperature and humidity and then calculates the heat index from the temperature and humidity estmates.





The data for these charts show that apparent temperatures exceeded 90 degrees for a total of 668 hours in Dorm A; 815 hours in Dorm C; and 725 hours in Dorm D during fewer than 71 days (1695 hours) of backcast. On average, then, heat index was greater than 90 degrees 43 percent of the time.

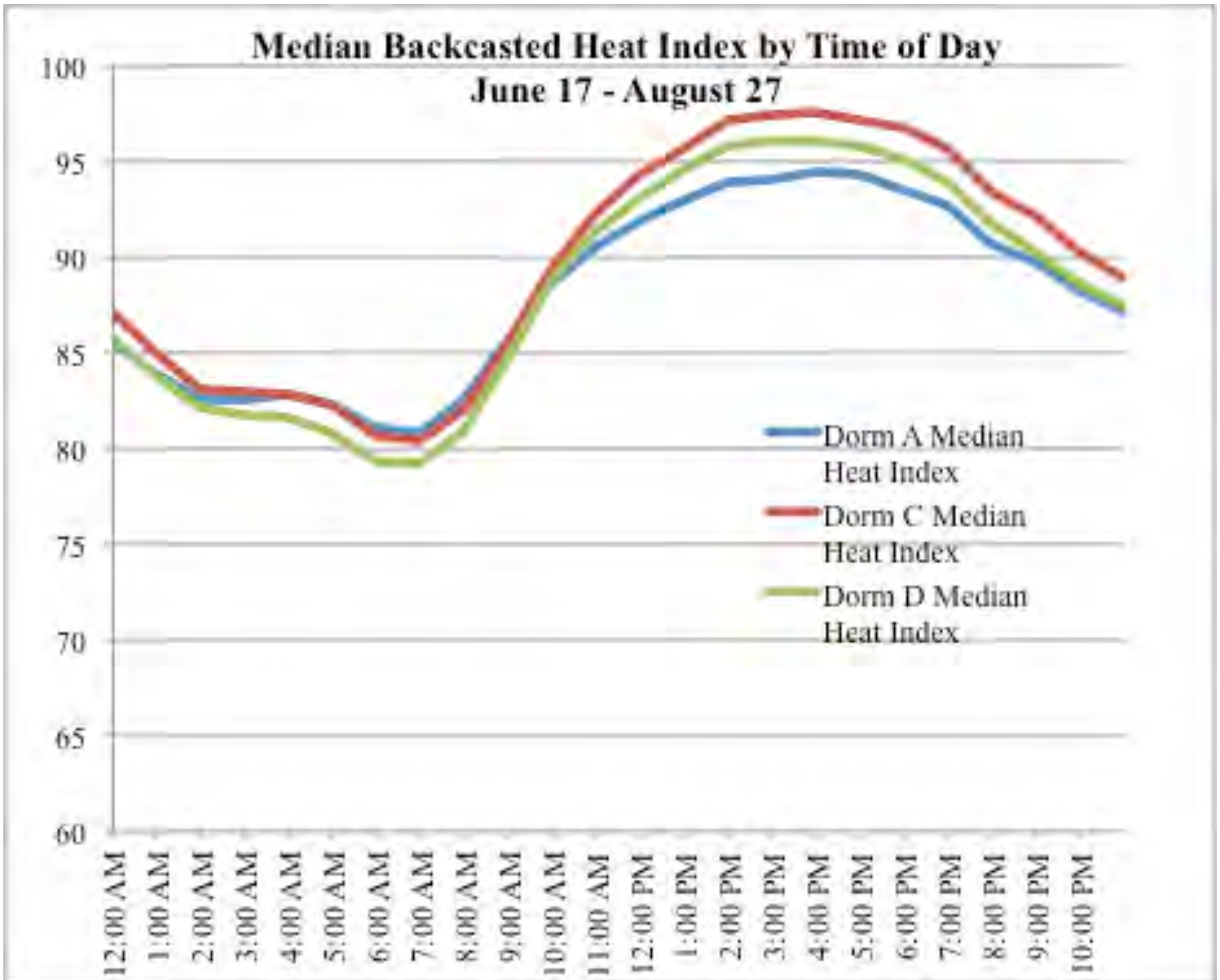
The data for these charts further show that apparent temperatures exceeded 95 degrees for a total of 191 hours in Dorm A; 447 hours in Dorm C; and 322 hours in Dorm D during fewer than 71 days (1695 hours) of backcast. On average, then, heat index was greater than 95

degrees 18 percent of the time.

The data for these charts show that apparent temperatures exceeded 100 degrees for a total of 1 hours in Dorm A; 113 hours in Dorm C; and 48 hours in Dorm D during fewer than 71 days (1695 hours) of backcast. On average, then, heat index was greater than 100 degrees 3 percent of the time.

D. Median of Modeled Heat Index by Time of Day

The data for the following chart and the larger, corresponding chart in Exhibit D show the median heat index during the period of measurement, June 17 to August 27, at each hour of the day. The "median" is the number halfway into a set of numbers, meaning that on half of the days measured, the heat index was at least as high as the median at the given hour, and on half of the days measured, the heat index was no higher than the median.



I, Thomas Sager, declare under the penalty of perjury that the foregoing is true and correct.

DATED this 17th day of December, 2015.

Signed: Thomas W. Sager

Thomas Sager

Exhibit A to the Declaration of Thomas Sager

The following chart is a compilation of the heat index entries that I computed and appended to my original report.

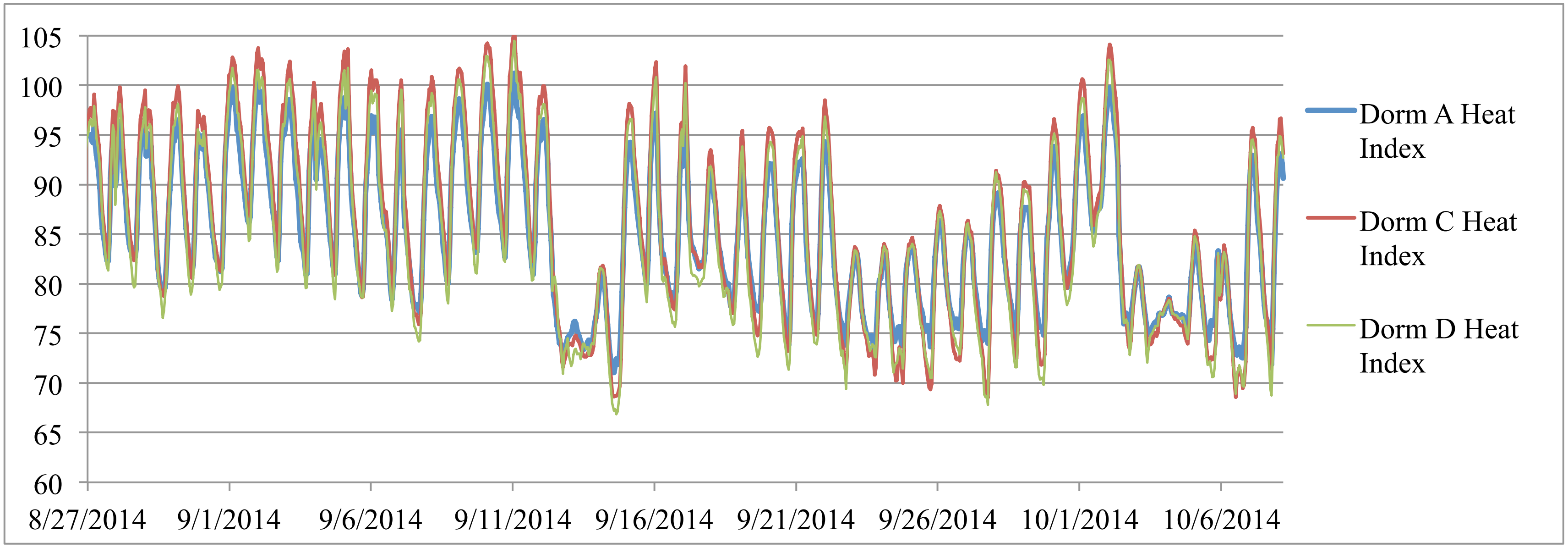


Exhibit B to the Declaration of Thomas Sager

The following chart shows the median heat index during the period of measurement, August 27 to October 8, at each hour of the day. The "median" is the number halfway into a set of numbers, meaning that on half of the days measured, the heat index was at least as high as the median at the given hour.

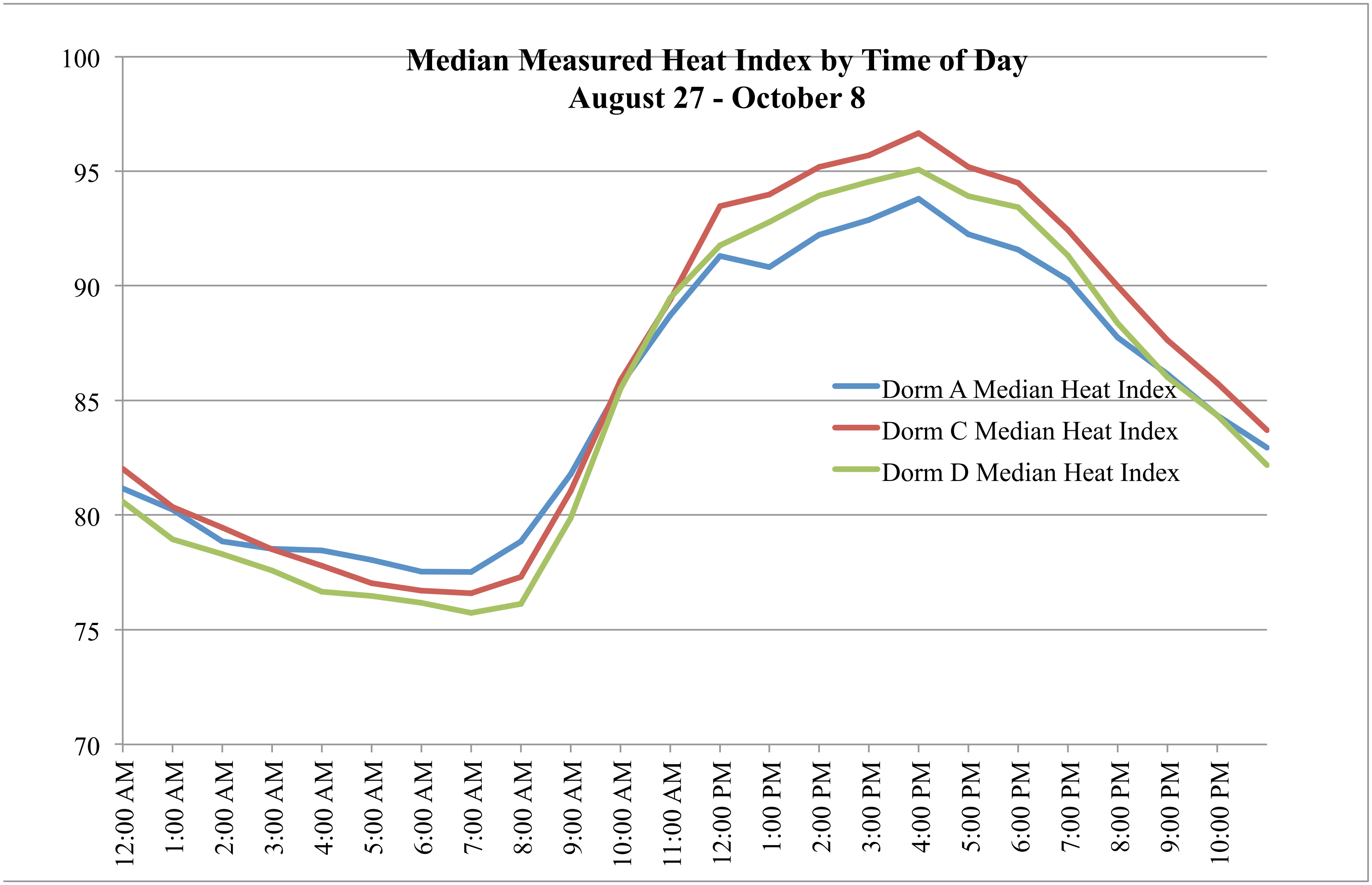
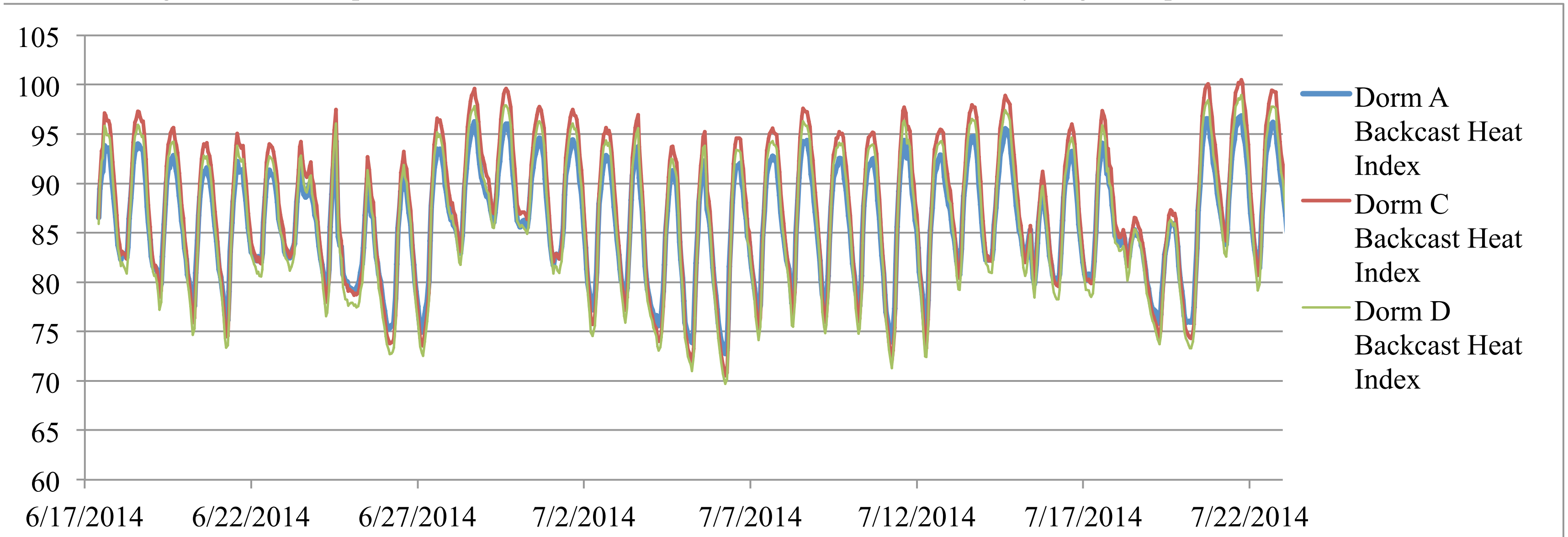


Exhibit B to the Declaration of Thomas Sager

Time	Dorm A Median Heat Index	Dorm C Median Heat Index	Dorm D Median Heat Index
12:00 AM	81.1625	82.02	80.5705
1:00 AM	80.246	80.339	78.9505
2:00 AM	78.843	79.4575	78.3035
3:00 AM	78.5335	78.4945	77.5785
4:00 AM	78.4535	77.7805	76.6415
5:00 AM	78.045	77.022	76.473
6:00 AM	77.5355	76.699	76.1705
7:00 AM	77.5155	76.5845	75.717
8:00 AM	78.8585	77.3095	76.1195
9:00 AM	81.779	81.0375	79.8565
10:00 AM	85.661	85.8825	85.4965
11:00 AM	88.713	89.393	89.484
12:00 PM	91.303	93.483	91.774
1:00 PM	90.817	93.98	92.776
2:00 PM	92.227	95.183	93.95
3:00 PM	92.866	95.693	94.542
4:00 PM	93.793	96.674	95.061
5:00 PM	92.251	95.198	93.906
6:00 PM	91.593	94.505	93.42
7:00 PM	90.266	92.429	91.339
8:00 PM	87.7405	89.9925	88.3735
9:00 PM	86.1405	87.6355	86.0215
10:00 PM	84.3525	85.7505	84.355
11:00 PM	82.935	83.698	82.1825

Exhibit C to the Declaration of Thomas Sager

The following charts are compilations of the modeled or "backcast" heat index from my original report.



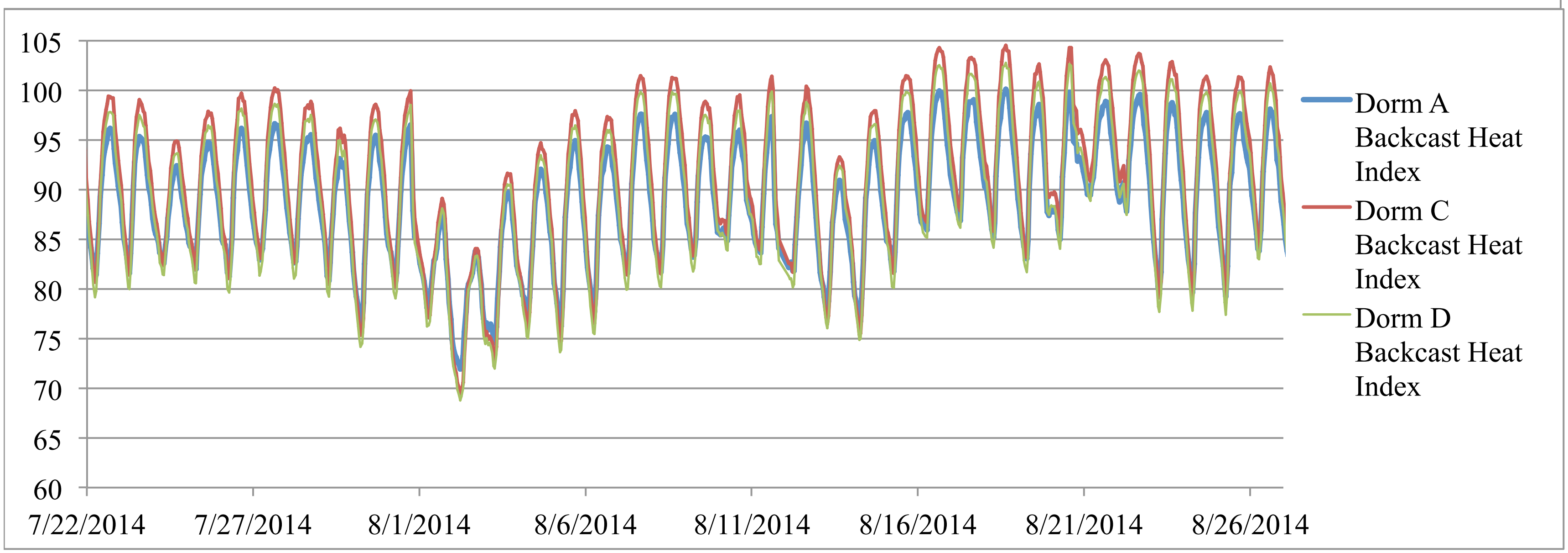


Exhibit D to the Declaration of Thomas Sager

The following chart shows the median heat index during the period of the backcast, June 17 to August 27, at each hour of the day. The "median" is the number halfway into a set of numbers, meaning that on half of the days measured, the heat index was at least as high as the median at the given hour.

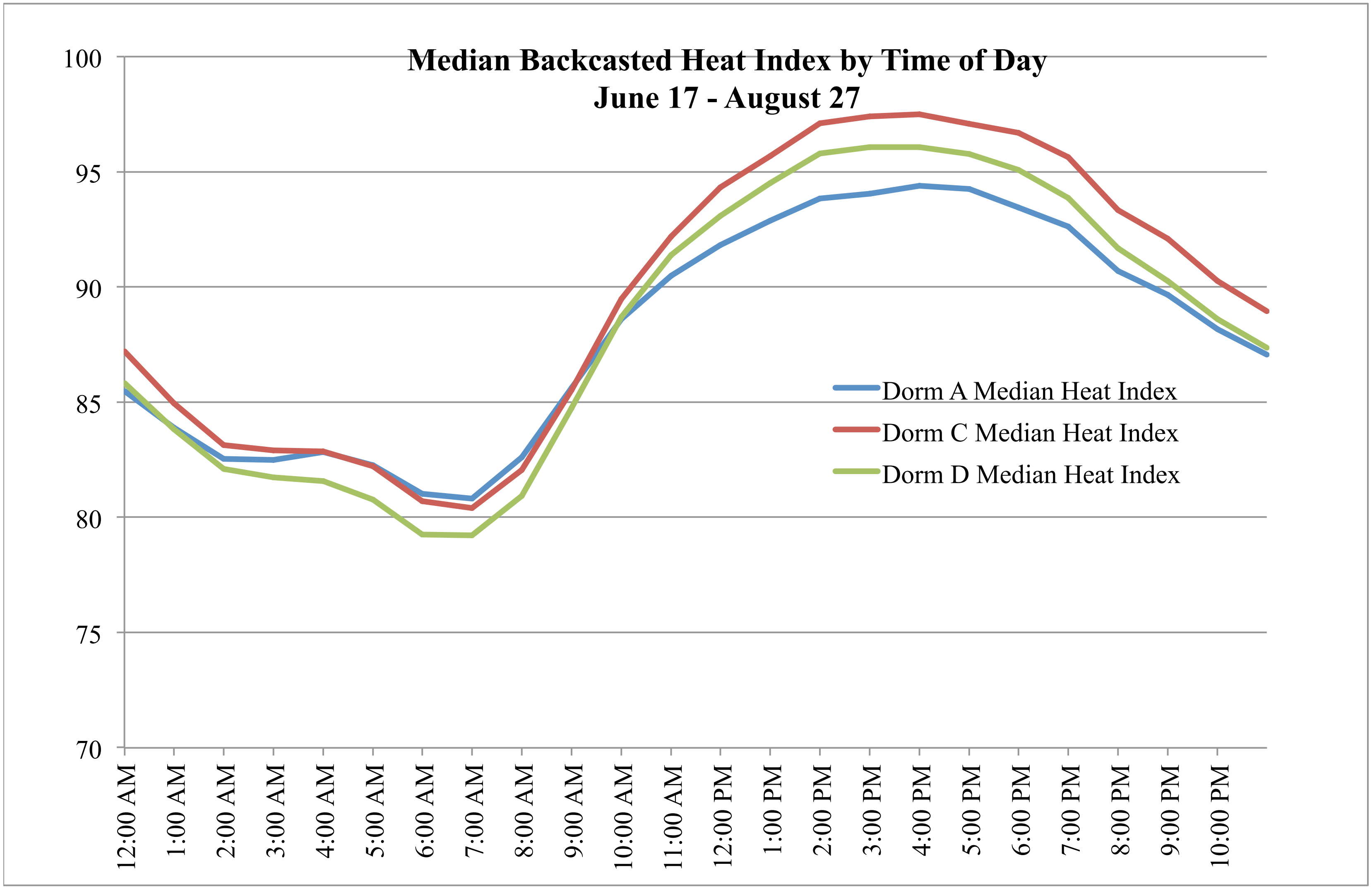


Exhibit D to the Declaration of Thomas Sager

Time	Dorm A Median Heat Index	Dorm C Median Heat Index	Dorm D Median Heat Index
12:00 AM	85.4895	87.192	85.8355
1:00 AM	83.897	84.9415	83.819
2:00 AM	82.5445	83.1435	82.093
3:00 AM	82.495	82.908	81.731
4:00 AM	82.841	82.859	81.563
5:00 AM	82.261	82.216	80.761
6:00 AM	81.025	80.703	79.254
7:00 AM	80.805	80.389	79.216
8:00 AM	82.608	82.046	80.932
9:00 AM	85.623	85.527	84.738
10:00 AM	88.598	89.472	88.7085
11:00 AM	90.486	92.2005	91.377
12:00 PM	91.815	94.323	93.094
1:00 PM	92.881	95.696	94.513
2:00 PM	93.839	97.105	95.809
3:00 PM	94.052	97.404	96.081
4:00 PM	94.405	97.499	96.065
5:00 PM	94.25	97.087	95.773
6:00 PM	93.454	96.698	95.085
7:00 PM	92.631	95.648	93.878
8:00 PM	90.698	93.349	91.681
9:00 PM	89.652	92.099	90.256
10:00 PM	88.179	90.265	88.597
11:00 PM	87.077	88.9425	87.361